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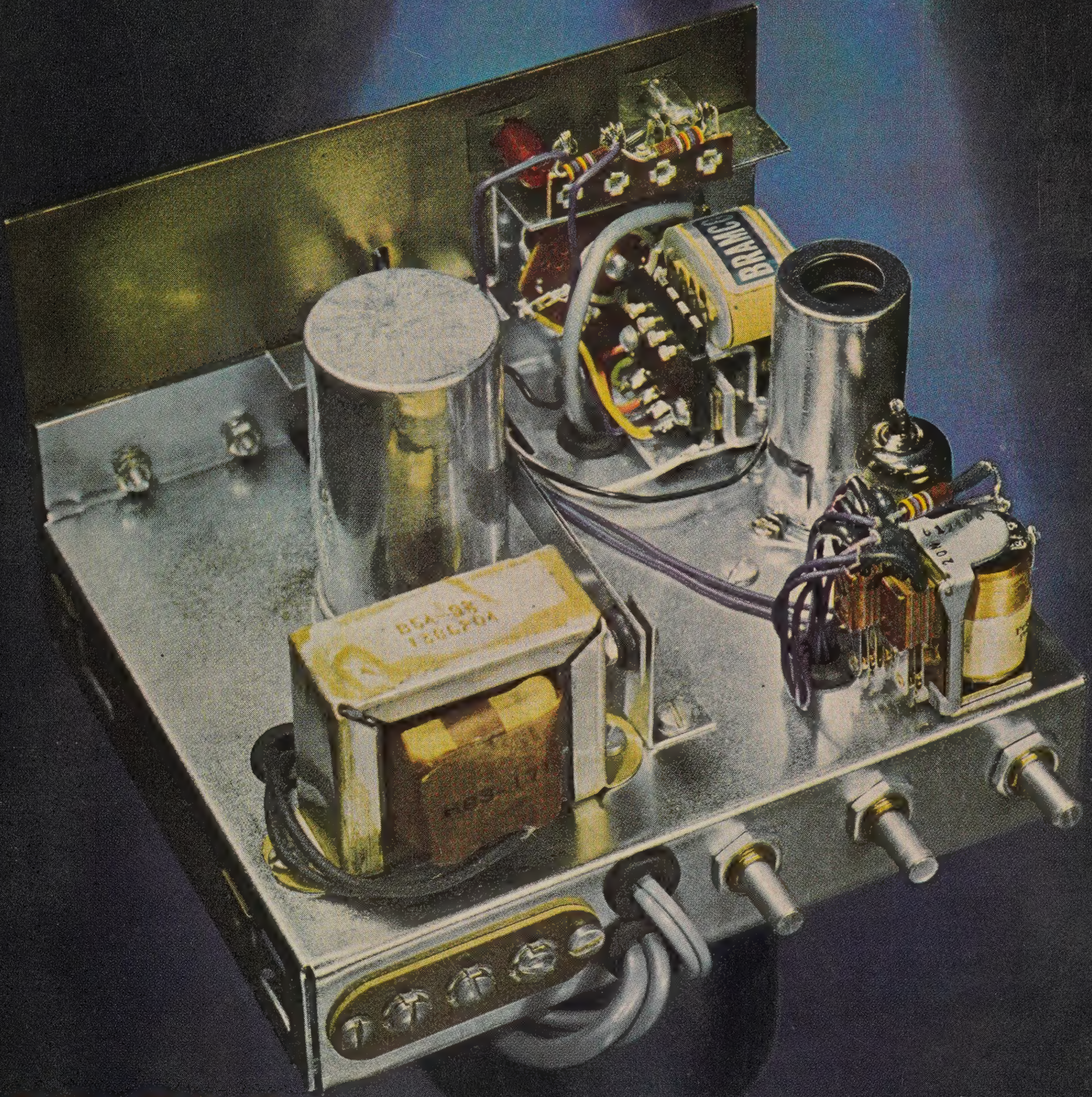

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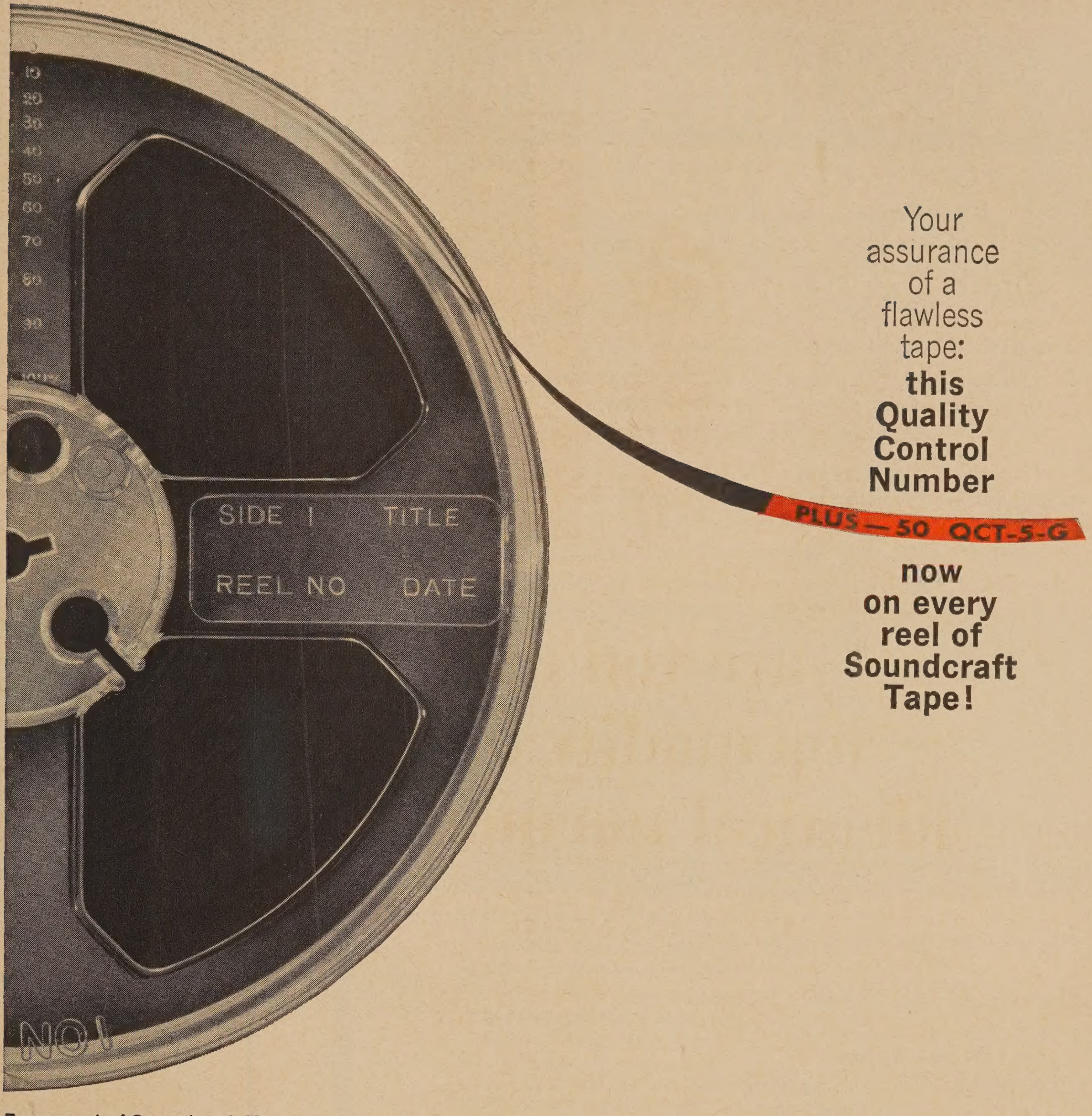
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VOL. XXXIV No. 3

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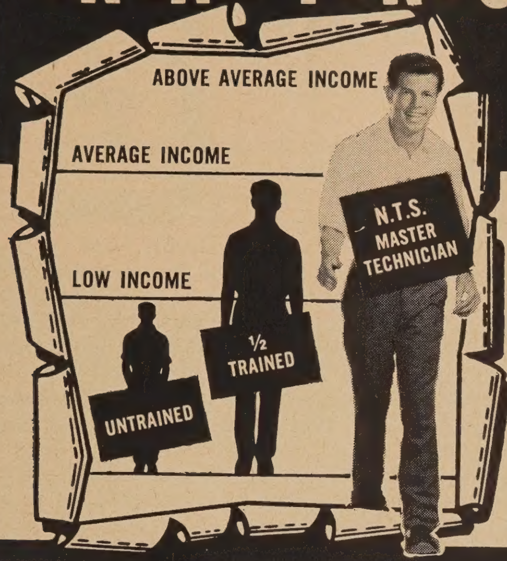

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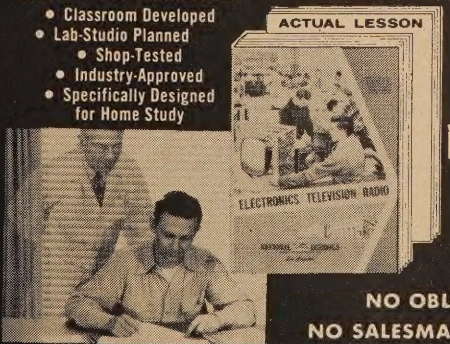

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News Briefs

FM Applications Frozen

The Federal Communications Commission has halted all applications for FM stations and changes in existing channels. Its proposed allocation system, based on mileage separations, has provoked severe criticism from supporters of the "protected contour." The commission hopes to resolve these conflicts before acting on the 1,530 FM channels still awaiting assignment.

Applications now on file will be kept there. After the ban is lifted, a period for filing new applications will be designated before any new grants are made. The ruling doesn't apply to areas where there are few cities and plenty of space, nor to most educational FM stations.

The "freeze" will last only till about June—the FCC hopes.

All-Time Record Set for Remote Electronic Repair

The most difficult repair job in the history of electronics was successfully completed when Telstar was activated after a 6-week period of silence. The problem was a fantastic one—there was no way of checking the equipment, and the only way to apply remedial measures was to send signals to a nonfunctioning receiver. The repair team had one clue—radiation in part of the satellite's orbit was 100 times as great as had been expected, and the symptoms during the breakdown period indicated possible radiation damage to transistors.

A duplicate Telstar was placed in a radiation field similar to that which surrounded the real satellite, and the likelihood of the defect was localized to a probable one out of three transistors. It was also found that removing the radiation gave the transistors an opportunity to recover their original condition, and that especially cutting off the voltage on the back-biased elements of the transistors speeded recovery.

A series of "diagnostic signals" was sent, further persuading the Bell Labs scientists that the difficulty was probably in a "zero gate". This was one of two transistors, and passed short pulses, while the other passed long ones, from the transmitters on earth. If the short-pulse gate could be bypassed, it might be possible to send commands to Telstar. An attempt was made to trick the long-pulse gate into recognizing short pulses by sending long dashes with notches in the center.

This worked to some extent, and the success with the few commands which the scientists were able to send confirmed the diagnosis. While working further in attempting to construct a command which would cause Telstar to disconnect the storage batteries, a lucky accident, or misinterpretation of the signals received, caused Telstar to turn off its battery. This occurred just before a series of eclipses by the earth, which cut off the power normally supplied by the solar cells, so the transistors received no power at all. The treatment was entirely effective, and both command receivers were returned to use—for how long, the Bell Labs would not venture to predict.

The repair team: John S. Mayo, left, holds the circuit diagram of the command decoder, while Rebert H. Shennum, center, points out the "zero beat" circuit in the duplicate model held by Henry Mann, right.

Fuel Cell Burns Hydrocarbons

A fuel cell that runs on inexpensive natural gas has been demonstrated by General Electric's Research Lab. Most earlier fuel cells (devices that convert chemical energy into electrical energy without moving parts) have operated on costly hydrogen, limiting their use to specialty applications. The new cells may provide power generators for industrial use, vehicles and bulk energy production, says Dr. Guy Suits, G-E vice president and director of research.

The cell recently demonstrated has a solid electrolyte made of zirconia. (The diagram shows how it works.) Several cells have been stacked together to form a "fuel battery". Estimated maximum efficiency of these fuel batteries is 30%, using natural gas, and even greater efficiency might be obtained with

(*Continued on page 10*)

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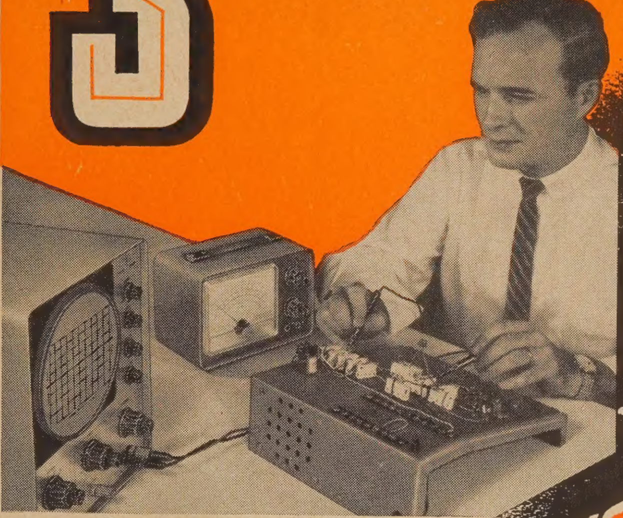

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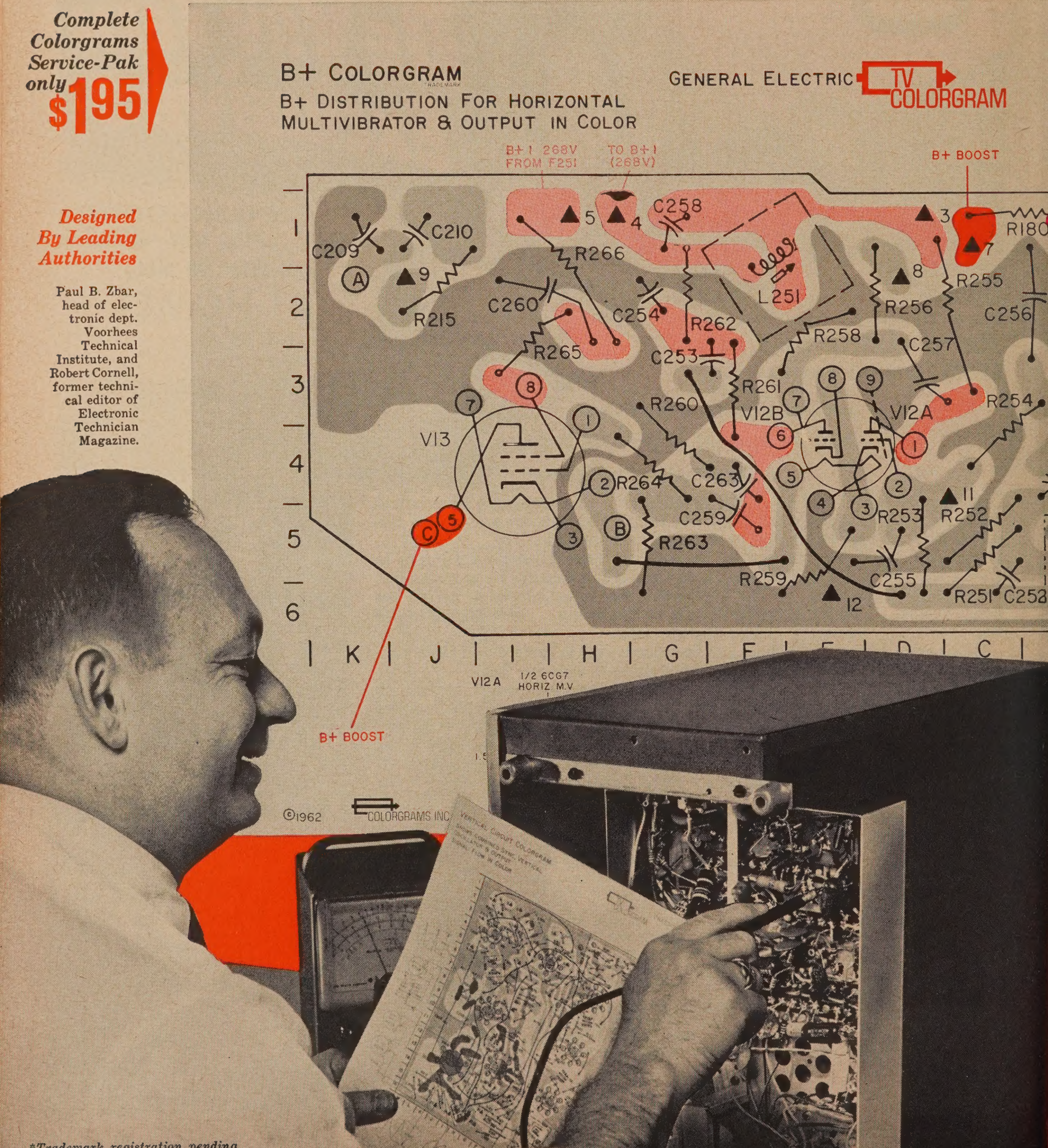
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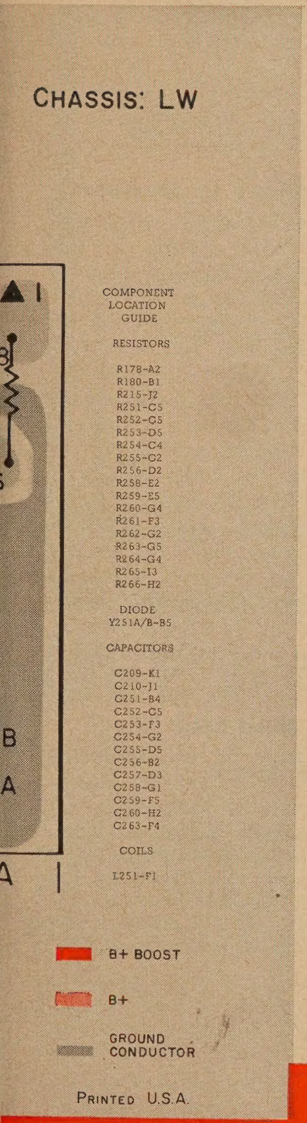
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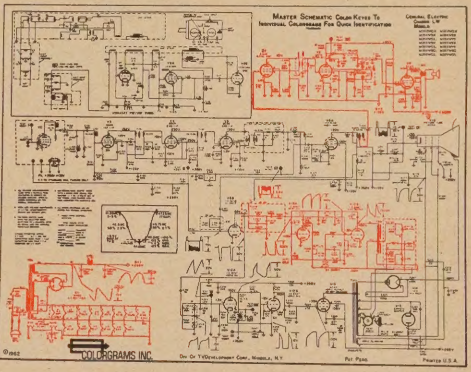
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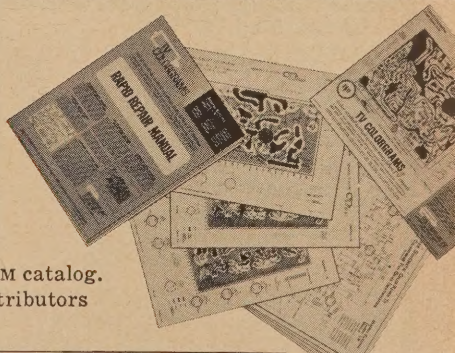
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Castle replaces all defective parts (tubes and major parts are extra at net prices) and then aligns your tuner to the exact, original specifications. Simply send us your defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint.

ALL MAKES ONE PRICE

VHF TUNERS
UHF TUNERS
UV COMBINATIONS*

9.95

*UV combination tuner must be of one piece construction. Separate UHF and VHF tuner with cord or gear drives must be dismantled and the defective unit sent in. 90 Day Warranty.

Send for FREE Mailing Kit and complete details

CASTLE
TV TUNER SERVICE, INC.

Check Map for the Castle Center Serving You.

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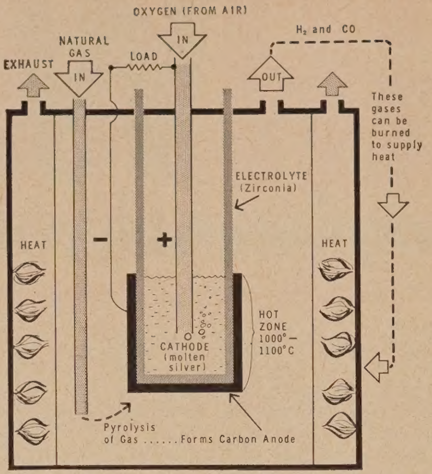
653 PALISADE BLVD., CLIFFSIDE PARK, N. J.
CANADA: 136 MAIN ST., TORONTO 13, ONTARIO

Pioneers in TV Tuner Overhauling


OXYGEN (FROM AIR)
IN
NATURAL GAS
IN
EXHAUST
LOAD
H_2 and CO
OUT
These gases can be burned to supply heat
ELECTROLYTE (Zirconia)
HEAT
−
+
HEAT
HOT ZONE 1000°—1100°C
CATHODE (molten silver)
Pyrolysis of Gas ......Forms Carbon Anode

(*Continued from page 6*)

other hydrocarbons. G-E scientists point out that the solid electrolyte has high structural and chemical stability and does not require large amounts of expensive catalytic electrode material. It is self-starting and maintains itself at approximately 2,000°F without externally applied heat.

G-E's low-cost fuel cell program encompasses a variety of types. Dr. Suits states, however, that "a great deal of research and development remains to be done before fuel cells operating on natural gas become marketable products."

Ultrasonic Waves Rotated by Magnetic Field

Scientists Herbert Matthews and R. Conway LeCraw report that ultrasonic waves, transmitted down a crystal of yttrium iron garnet, are rotated if a dc magnetic field is applied parallel to the axis of the cylinder, so that the magnetic moments of the iron atoms in the garnet line up parallel to the field.

A quartz disk, bonded to one end of the cylinder, was excited with 500-mc pulses, thus generating an ultrasonic wave of the same frequency. As the waves traveled down the cylinder, they were rotated 45° by the magnetic field, and the reflected waves were rotated another 45° in the same direction.

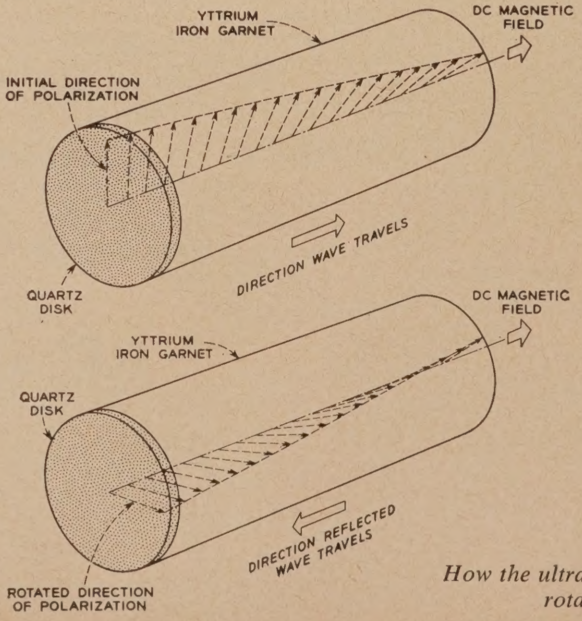
This could make a new family of ultrasonic devices possible. The rotation of 90° would make it possible to use the device as an isolator. The reflected waves polarized at 90° could be absorbed by an attenuator without affecting waves traveling at the original zero-degree rotation.

Pay-TV to Start in Denver

The FCC has approved the second pay-television system in the United States. The Teleglobe-Denver Corp. is expected to introduce the new system in Denver within the next 3 months. The Teleglobe system (page 18, June 1962, page 58, this issue), which requires no signal scrambling or attachment to the set, will be used. A picture is broadcast without sound. The audio portion is carried on telephone lines to separate speakers in the home. Turning on the speaker automatically bills the viewer for the program watched. The Teleglobe-Denver Corp. is two-thirds owned by Macfadden-Bartell and one-third by Teleglobe Pay-TV Systems.

Now—The Madistor

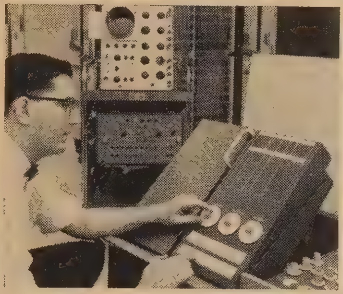
A new type of semiconductor device has been described by Massachusetts Institute of Technology scientists I. Melngailis and R. H. Rediker. The new member of the semi-


YTTRIUM IRON GARNET
DC MAGNETIC FIELD
INITIAL DIRECTION OF POLARIZATION
QUARTZ DISK
DIRECTION WAVE TRAVELS
DC MAGNETIC FIELD
YTTRIUM IRON GARNET
QUARTZ DISK
DIRECTION REFLECTED WAVE TRAVELS
ROTATED DIRECTION OF POLARIZATION

How the ultrasonic wave is rotated.

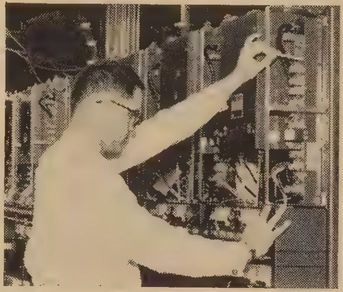
Pick the course for your career...

Electronics Technology



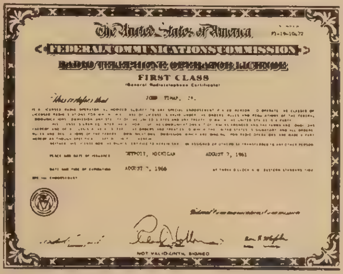
A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Television, Transistors, and preparation for a 1st Class FCC License.

Electronic Communications



Mobile Radio, Microwave and 2nd Class FCC Preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.

First Class FCC License



The United States of America

FEDERAL COMMUNICATIONS COMMISSION

RADIO TELEPHONE OPERATOR LICENSE

FIRST CLASS

(General Radiotelephone Certificate)

DETROIT, MICHIGAN AUGUST 7, 1961

AUGUST 7, 1966

NOT VALID UNTIL SIGNED

If you want a 1st Class FCC ticket quickly, this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.

Broadcast Engineering

Here's an excellent studio engineering program which will get you a 1st Class FCC License and teach you all about Program Transmission and Broadcast Transmitters.

Get A Commercial FCC License ...Or Your Money Back!

A Commercial FCC License is proof of electronics skill and knowledge. Many top jobs require it . . . every employer understands its significance. In your possession, an FCC Commercial Ticket stamps you as a man who knows and understands electronics theory . . . a man who's ready for the high-paid, more challenging positions.

Cleveland Institute home study is far and away the quickest, most economical way to prepare for the FCC License examination. And that's why we can make this exclusive statement:

> The training programs described above will prepare you for the FCC License specified. Should you fail to pass the FCC examination after completing the course, we will refund *all* tuition payments. You get an FCC License . . . or your money back!

Before you turn this page, select the program that fits your career objective. Then, mark your selection on the coupon below and mail it to us today. We'll send you . . . without obligation . . . complete details on our effective Cleveland Institute home study. Act NOW . . . and insure *your* future in electronics.

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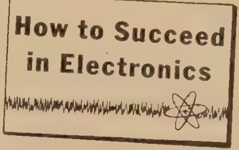

How to Succeed in Electronics

Please send FREE Career Information prepared to help me get ahead in Electronics, without further obligation.

CHECK AREA OF MOST INTEREST—

☐ Electronics Technology
☐ Industrial Electronics
☐ Broadcast Engineering
☐ First Class FCC License
☐ Electronic Communications
☐ ______________ other

Your present occupation______________

Name______________ Age______
(please print)

Address______________

City______________ Zone____ State______

RE-77

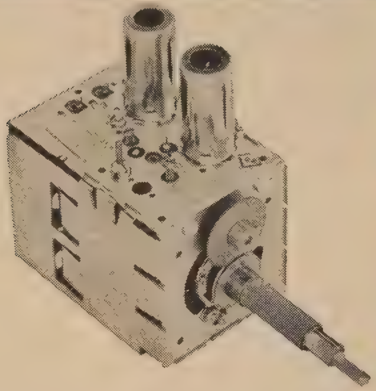
Prices effective January 1, 1963

Tarzian offers
FAST, DEPENDABLE
TUNER REPAIR
SERVICE (ALL MAKES)

ONLY
$9.50
INCLUDING

ALL PARTS
(except tubes)
and LABOR

24-HOUR SERVICE
1-YEAR WARRANTY



It just makes sense that a manufacturer of tuners should be better-qualified, better-equipped to offer the most dependable tuner repair and overhaul service.

Sarkes Tarzian, Inc. pioneer in the tuner business, maintains two complete, well-equipped Factory Service Centers—assisted by Engineering personnel—and staffed by specialized technicians who handle ONLY tuner repairs on ALL makes and models.

Tarzian-made tuners received one day will be repaired and shipped out the next. Allow a little more time for service on other than Tarzian-made tuners.

Tarzian offers a 12-month guarantee against defective workmanship and parts failure due to normal usage. And, compare our cost of $9.50 and $15 for UV combinations. There is absolutely no additional, hidden charge, for ANY parts except tubes. You pay shipping costs. Replacements on tuners beyond practical repair are available at low cost.

Tarzian-made tuners are identified by this stamping. When inquiring about service on other tuners, always give TV make, chassis and Model number. All tuners repaired on approved, open accounts. Check with your local distributor for Sarkes Tarzian replacement tuners, replacement parts, or repair service.

TWO SERVICE CENTERS
TO SERVE YOU BETTER

See your distributor, or use the address nearest you for fast factory repair service

537 South Walnut St.
Bloomington, Indiana
Tel: 332-6055

10654 Magnolia Blvd.
North Hollywood, Calif.
Tel: 769-2720

SARKES TARZIAN, INC.
Bloomington, Indiana

MANUFACTURERS OF TUNERS . . . SEMICONDUCTORS . . . AIR TRIMMERS . . . FM RADIOS . . . AM/FM RADIOS . . . AUDIO TAPE . . . BROADCAST EQUIPMENT

SAY YOU
SAW IT
ADVERTISED IN . . .
Radio-Electronics

conductor family uses the effects of a magnetic field on an injection plasma in a semiconductor. The plasma is formed by injecting minority carriers into an indium-antimony semiconductor from the forward-biased junction, and controlling the position of the plasma by small magnetic fields. The action takes place only at low temperatures, experiments having been performed at 77°K.

The madistor, by the way, is not another of the names that have grown up around a recent popular magazine, but an acronym for *mag*netic *d*eflection of an *i*njection plasma produced by *s*aturating *tr*aps.

New Name for IHFM

The Institute of High Fidelity Manufacturers will now be known as the Institute of High Fidelity, Inc. The membership voted the change during the New York High Fidelity Show, to allow for the broadening scope of the group's activities and the inclusion of audio reps and dealers.

TV Masts Plus Power Lines Fatal to 3 Kentuckians

Three persons in the same area were killed within a week by contact of a television antenna with a high-tension line. Charles H. Carwile and his son, Staff Sgt. Thomas Carwile, of Hardinsburg, Ky., were fatally shocked when an antenna they were moving from their home touched a high-voltage wire. Four days before, in nearby Somerset, Ky., William Ivan Junglin, 36, a service station owner, was killed when the TV antenna he was installing on his roof brushed against a power line.

Dr. Dellinger Dies

J. Howard Dellinger, who initiated radio research at the National Bureau of Standards in 1911, died Dec. 28, 1962, at the age of 76. Dr. Dellinger had worked with the NBS

from 1907 to 1948, becoming chief of the Radio Section in 1919. After his retirement from NBS in 1948, he continued as a consultant and adviser.

Dr. Dellinger was chiefly famous

(Continued on page 18)

POWER
TRANSFER OSCILLATOR
HEWLETT PACKARD
1963
electronics
CREI
The Capitol Radio Engineering Institute · Washington, D.C., U.S.A.

IN THE MISSILE PROGRAM *at Vandenberg Air Force Base is CREI graduate Robert N. Welch. Moving ahead rapidly since enrolling with CREI, he is now a Philco TechRep Engineer and section leader in the Precision Measurement Equipment Laboratory*

If you are employed in electronics

WE WANT TO SEND YOU THE FREE BOOK

that started this man on the way to a rewarding career

Today Robert N. Welch has a well-paying, exciting position in space age electronics. But he held a routine job when he sent for our free book, "Your Career in Electronics and Nuclear Engineering Technology".

From this 58-page book, he discovered the real reason why some men move ahead in electronics while others stand still. He learned the vital importance of advanced knowledge of electronics to a man who cannot be satisfied with an uninteresting, low-paying job. He found out why CREI Home Study Programs are recognized by leading organizations as particularly effective preparation for a career in advanced electronics. Mr. Welch is just one of thousands of men in every phase of electronics who profited from reading this book. Send for free copy. Use coupon or write: The Capitol Radio Engineering Institute, Dept. 1403A, 3224 16th St., N.W., Wash. 10, D. C.

CREI *Founded 1927*
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Please send me FREE book describing career opportunities and CREI Programs in advanced electronics. I am employed in electronics and have a high school education.

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38

SERVICE TECHNICIANS, ENGINEERS, TEST LABS SAY . . . THE POPULAR MIGHTY MITE IS

"The Best Tube Checker they ever used."

SPEEDY SET-UP CHART
A
B
C
D
LOAD
FUNCTION
MIGHTY MITE
SENCORE

Here it is . . .

THE **MIGHTY MITE**

Designed for the present and far into the future. Tests all of your present tubes plus the new RCA Nuvistors and Novars, GE Compactrons and Sylvania 10 pin tubes.

Finds 'em Fast! Checks 'em All!

A complete tube tester that is smaller than a portable typewriter yet outperforms testers costing hundreds of dollars. A real money maker for the serviceman and a trusty companion for engineers, maintenance men and experimenters.

Even though the Mighty Mite weighs less than 8 pounds, new circuity by Sencore enables you to use a meter to check grid leakage as high as 100 megohms and gas conditions that cause as little as one half microamp of grid current to flow. Then too, it checks for emission at operating levels and shorts or leakage up to 120,000 ohms between all elements. This analytical "stethoscope" approach finds troublesome tubes even when large mutual conductance testers fail. And it does all this by merely setting four controls labeled A, B, C, & D.

Check these plus Sencore features: New, stick-proof D'Arsonval Meter will not burn out even with a shorted tube • Meter glows in dark for easy reading behind TV set. • New large Speedy Set-Up Tube Chart in cover, cuts set-up time • Rugged, all-steel carrying case and easy grip handle • Smallest complete tester made, less than one foot square. • The Mighty Mite will test every standard radio and TV tube that you encounter, nearly 2000 in all, including foreign, five star, auto radio tubes (without damage) plus the new GE Compactrons, RCA Nuvistors and Novars and Sylvania 10 pin tubes.

Mighty Mite also has larger, easy-to-read type in the set-up booklet to insure faster testing. Why don't you join the thousands of servicemen, engineers, and technicians who now own a Mighty Mite tube tester? Tube substitution is becoming impossible and costly with nearly 2000 tubes in use today. Ask your authorized Sencore Distributor for the New Improved Mighty Mite. Size: 10¼" x 9¼" x 3½". Wt. 8 lbs.

MODEL TC114 Dealer Net **$74.50**

Sencore Sam says . . "They all agree . . . the Mighty Mite is the real answer for the man on the go."

SENCORE ADDISON, ILLINOIS

your move!
FCC

The move into electronics is your decision. GRANTHAM SCHOOL OF ELECTRONICS makes your move easier . . .

. . . easier by teaching you electronics in a logical, step-by-step manner, while preparing you to qualify for your **First Class Commercial FCC License.** This license is a "diploma" issued by the U. S. Government to certify qualified electronics technicians, and is awarded only to those who pass certain technical FCC examinations. We teach you electronics and prepare you to pass these FCC examinations.

Grantham training is **Specialized Training,** endorsed and recommended by many electronics firms throughout the nation, and accredited by the National Home Study Council. We teach you the **how** and **why** of basic electronics, with the necessary math taught as an integral part of the lessons. The course is thorough, easy to understand, and lays a solid foundation for all types of electronics work—communications electronics, military electronics, computer electronics, automation electronics, broadcasting electronics, and many more.

The time required to prepare for your first class FCC license, an important step toward your goal, is cut to a minimum through quality instruction—**either by home study or in resident classes.** You learn more electronics in less time because the Grantham Method is engineered with the student in mind. Complete details concerning Grantham training are available free for the asking. Now, it's up to you—**it's your move!**

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Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

Name ____________________ Age ______

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City ____________________ State ______

I am interested in: ☐ Home Study, ☐ Resident Classes

NEW!

INTERNATIONAL EXECUTIVE TRANSCEIVER

Model 1500

G
CHANNEL
Executive
INTERNATIONAL CRYSTAL MFG.
1

Designed for the Hobbyist . . . Complies with FCC Part 15 (no license) requirements

Here is International's new Model 1500 Executive transceiver for radio communication within the 27 mc frequency range. Designed and engineered for phone and cw (code), you can talk from 1 to 10 miles with other Part 15 stations depending on the height of the antenna. You are also permitted to work skip signals 1,000 miles or more with other Part 15 stations when a band opening occurs. And . . . no FCC license is required.

This feature packed transceiver puts the maximum RF power into the antenna by combining the transmitter and antenna for rooftop mounting. A second unit houses a supersensitive receiver and exciter, while a preamplifier at the antenna boosts weak signals for better reception. Other features include a special crystal filter for reducing interference from adjacent channel Class D two-way radios.

- **100 milliwatts input / 60″ antenna**
- **115 vac operation**
- **Phone and CW**
- **Eight channels . . . crystal controlled**
- **27 mc frequency range**

A complete, "ready to go", package. 1 receiver/exciter complete with 8 sets of crystals, 2 transmitter/antenna assembly, 3 antenna mount, 4 5 foot mast, 5 100 feet of control cable, 6 microphone, 7 key for (CW)

Model 1500 transceiver complete.................................$299.50*

See the Model 1500 transceiver at your International dealer.
* other models from $80.00

5
7
6
INTERNATIONAL

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CRYSTAL MFG. CO., INC.
18 NORTH LEE • OKLAHOMA CITY, OKLA.

Write today for International's 1963 catalog.

Control replacement: It's a snap!

WITH CENTRALAB'S NEW FASTATCH® II CONTROL KIT

NEW CENTRALAB KIT PROVIDES COMPREHENSIVE COVERAGE OF SINGLE AND DUAL CONCENTRIC CONTROLS. STOCK ADJUSTMENTS ON YOUR PRESENT CENTRALAB CONTROLS, TOO!

FASTATCH II CONTROLS
FASTATCH II CONTROLS
FASTATCH II SHAFTS
FASTATCH II SHAFTS
FRK-100 KIT

FASTATCH II gives you these new exclusive features:

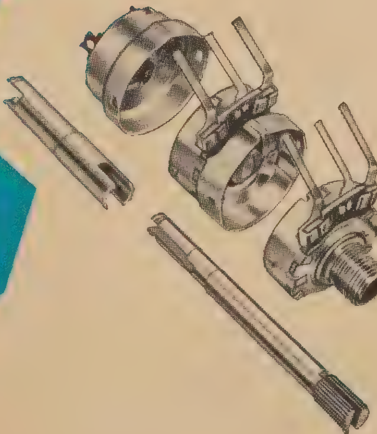
1. Just one control system for dual concentric or single controls.
2. Plug-in permanent locking shafts.
3. Universal terminals.
4. Both front and rear units accommodate KR (snap-on) line switches.

- **IT'S A SNAP to own!** Trade-in your present stock of Fastatch parts.
- **IT'S A SNAP to use!** Single and dual concentrics snap together without tools! Current cross-reference guide is included. Choose from 6 types of universal shafts for either singles or duals—shorten to exact length for your specific needs. 139 exact shafts also available.
- **IT'S A SNAP to guarantee!** Assembled units can't loosen—shafts can't pull out.
- **IT'S A SNAP to store!** Your Fastatch II FRK-100 Kit is built into a heavy gauge steel cabinet. All of your control needs and your cross-reference guide are ready for instant service.

The FRK-100 KIT contains:

27 assorted front controls
9 assorted rear controls
40 assorted universal shafts for singles and dual concentrics
5 SPST on/off switches
2 DPST on/off switches
1 DP on/off switch

Packaged in heavy gauge steel cabinet: complete with current cross-reference guides.



Total Value: $55.80 Your money-saving price: **$48.55**

LESS CREDIT for your Old F and R stock!

See your Centralab distributor!

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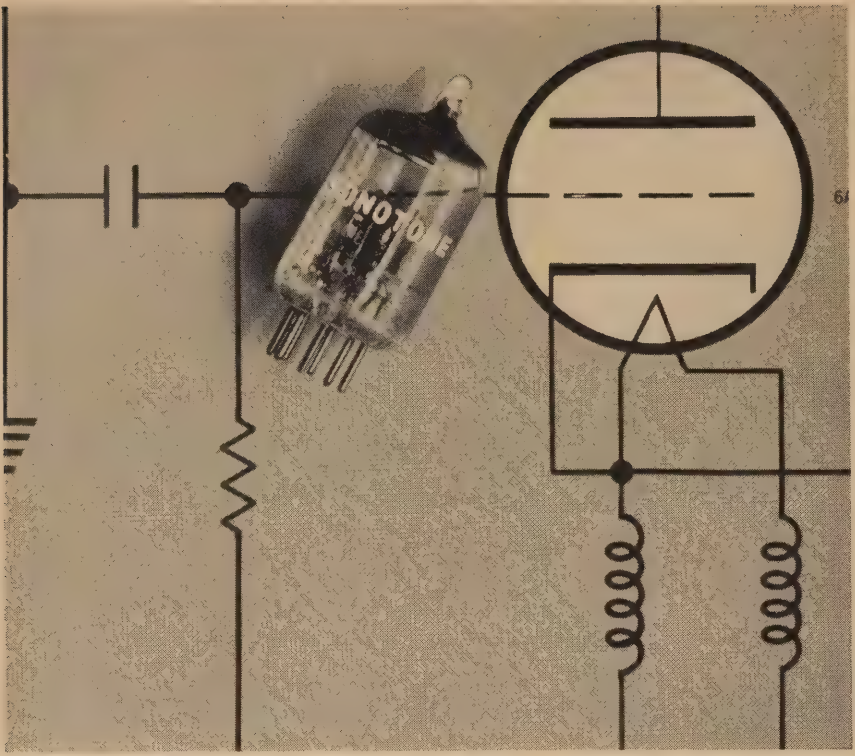


WON'T JUST ANY 6AF4A DO?

All 6AF4A tubes are designed for UHF applications — the Sonotone 6AF4A even more so! And when you're up around 800 megacycles, the extra stability you get with the Sonotone 6AF4A can make a world of difference in the performance of the unit.

There are any number of problems which the tube can introduce in a UHF oscillator circuit — drift, spurious oscillation, general instability and just plain malfunction. Whether or not they arise depends upon the tube you use. The Sonotone 6AF4A performs as it does because the manufacturer has taken unusual pains to maintain certain standards.

Every Sonotone 6AF4A is individually evacuated. A mechanically defective tube cannot contaminate the others. And any defective tube will be automatically rejected in the tests to which each tube is subjected.

More manufacturers of UHF tuners and converters specify the Sonotone 6AF4A than any other single make. Their engineers have learned that they can rely on the extra quality and performance which Sonotone engineers into its tubes. Next time you have to replace a 6AF4A, it makes sense to use a tube that will protect you from callbacks.

Just as in the 6AF4A — there's something extra engineered into all Sonotone tubes. It stands to reason that, as the first electron tube manufacturer to qualify for complete RIQAP (Reduced Inspection Quality Assurance Program) participation by the U. S. Army Signal Corps, Sonotone engineers a top quality tube. Sonotone offers more than 200 tube types; including many hard-to-get European types — home entertainment and industrial. All conform to the same high standards and are your key to replacement profits. Replace with Sonotone.

SONOTONE® CORPORATION

ELECTRONIC APPLICATIONS DIVISION • ELMSFORD, NEW YORK

Cartridges • Speakers • Tape Heads • Microphones • Electron Tubes • Batteries • Hearing Aids

(Continued from page 12)

for his discovery of the simultaneous occurrence of solar eruptions and radio disturbances (the Dellinger effect). He was also responsible for initiating the US standard-frequency broadcast service (WWV), carried on studies in radio propagation at high frequencies, and supervised the development of many basic radio aids to air navigation.

Author of more than 200 technical papers, Dr. Dellinger was the radio editor of Webster's Dictionary, and a Fellow of the IRE (president in 1925, vice president in 1924).

CALENDAR OF EVENTS

International Solid State Circuits Conference, Feb. 20–22; Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

San Francisco High Fidelity Show, Mar. 6–10; Cow Palace, San Francisco, Calif.

International Sound Equipment Exhibition, Mar. 7–12; Palais d'Orsay, Paris, France.

Symposium on European Markets for Electronic Products, Electronic Industries Association, Mar. 19; Statler Hilton Hotel, Washington, D.C.

Electronics Industries Assoc. Spring Conference, Mar. 20–22; Statler Hilton Hotel, Washington, D.C.

1963 IEEE Convention, Mar. 25–28: Waldorf-Astoria Hotel and Coliseum, New York.

SSB Amateur Radio Association 12th Annual SSB Dinner and Hamfest, Mar. 26: Hotel Statler Hilton, New York.

High Fidelity Music Show, Institute of High Fidelity, Apr. 2–7: Ambassador Hotel Cottages, Los Angeles, Calif.

Symposium on Optical Masers, sponsored by IEEE, **Optical Society of America and U.S. Defense Research Agencies**, Apr. 16–18; Waldorf-Astoria Hotel, New York.

Convention of the British Institution of Radio Engineers, Apr. 16–20; University of Southampton, England.

Southwestern IRE Conference and Electronics Show (SWIRECO), Apr. 17–19; Dallas, Tex.

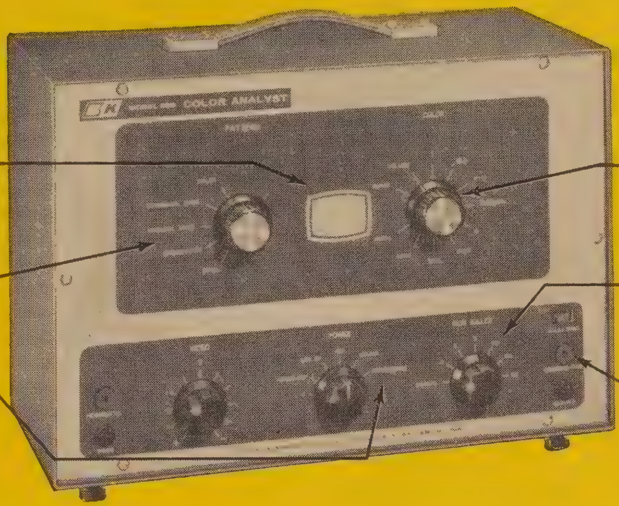
Venus Lacks Magnetic Field—Maybe

In its December flight, the Mariner II interplanetary probe found no magnetic field around Venus. Mariner project scientist Paul J. Coleman states, however, that it's too soon to form conclusions. All we know at this time is that the magnetic field—if there is one—does not extend out to the Mariner trajectory. It may be that a solar wind confines a weak field to a limited region close to the planet, he says, or that planets rotating more slowly than the earth produce smaller magnetic fields.

New Machine Can Read 20 Kinds of Type

A new electronic multi-font print reader that can read type and convert it into data on punched cards or tape at the rate of 700 characters per second has been developed

NOW *EVERYONE* CAN QUICKLY Set up and Service Color TV



1 **PATTERN DISPLAY STANDARD** Shows correct pattern in window viewer for visual guide

2 **PATTERN SELECTOR** Produces each pattern individually for quick, easy convergence

3 **AUTOMATIC DECONVERGENCE** Simplifies static and dynamic convergence. No digging into set

4 **COLOR SELECTOR** Produces each color one at a time for accurate color set-up

5 **COLOR GUN KILLER** Automatically enables the technician to actuate any combination of the 3 guns

6 **DEMODULATOR ALIGNMENT** Makes alignment extremely simple, without going into the color set

New! B&K Model 850 COLOR GENERATOR

Most Complete, Most Versatile, Portable Instrument for Use in the Home and in the Shop
Makes Color TV Set-up and Service Easier, Faster than ever!

Now every service technician can be ready to set-up and service color TV with amazing new ease and speed! New advanced design simplifies the entire operation, saves time and work in every installation. Eliminates difficult steps in digging into the color TV set. Gives you new confidence in handling color.

Produces Patterns, Burst, and Colors Individually—Provides dot pattern, crosshatch, vertical lines, horizontal lines, burst signal, and individual colors—one at a time—on the TV color set—for fastest, easiest check. Unique window-viewer on front of the instrument panel shows you each pattern as it should be—gives you an exclusive display standard to use as a sure guide for quick, visual comparison.

Provides Accurate, Individual Color Display—Produces Green, Cyan, Blue, B—Y, Q, Magenta, R—Y, Red, I, Yellow, and Burst—one at a time. All colors are crystal-controlled and are produced by a precision delay-line for maximum accuracy. Each color is individually switch-selected—no chance of error.

Provides Accurate NTSC-Type Signal—Color phase angles are maintained in accordance with NTSC specifications.

Makes Convergence and Linearity Adjustments Easy—Highly stable crystal-controlled system with vertical and horizontal sync pulses, assures the ultimate in line and dot stability.

Simplifies Demodulator Alignment—The type of color display produced by this instrument provides the ultimate in simplicity for precise demodulator alignment.

Provides Automatic Deconvergence—Eliminates the necessity for continual static convergence adjustments. The instrument automatically deconverges a white into a color dot trio without digging into the color set to misadjust the convergence magnets. It also deconverges a white horizontal or vertical line into red, green and blue parallel lines. This greatly simplifies dynamic convergence adjustments.

Provides Exclusive Color Gun Killer—Front-panel switch control makes it easy to disable any combination of the three color guns. Eliminates continuous adjustment of the background or screen controls, or connection of a shorting clip inside the receiver. The switch also selects the individual grids of the color tube and connects to a front-panel jack to simplify demodulator alignment.

Provides Switch-Selected R.F. Signals—Factory-tuned, for channels 3, 4, and 5—for open channel use in your area.

Model 850 also includes other features that make it invaluable for home and shop use. Net, **$199.95**

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First-rate quality just doesn't happen by chance...you have to work at it. This is just as true in the manufacture of capacitors as it is in radio-TV-electronics servicing. You know that you cannot expect repeat business unless you have built a reputation for dependability and honest service. If you're particular about your service and your profits...be particular about the capacitors you use. Take ceramic capacitors, for example. Aerovox offers you a complete line of rugged, dependable and proven top-quality ceramic capacitors in every case style for your every replacement need. See your Aerovox Distributor for a wide selection of disk types for by-pass coupling, general purpose, hi-voltage and temperature compensating applications. Yes, he stocks cartwheels, standoffs and feedthrus, too. And for real "plus" profits ask about kits AK-200 and AK-201HS. Remember, it pays to use Aerovox!

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Stand-Off
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Disk

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The new Sylvania print reader scans typewritten copy (left) and turns it into data on a punched tape.

by Sylvania Electric Products, Inc. The machine can read up to 20 type faces from $\frac{1}{12}$ to $\frac{1}{2}$ inch in height, while handling 700 characters per second. Speeds up to 20,000 per second are feasible, according to Dr. James E. Storer, director of Sylvania's Applied Research Laboratory. At a speed of 20,000 characters per second, the unit could convert the new Webster's Unabridged Dictionary into computer language in about an hour. The new development is expected to be a major step toward satisfying the requirements of high-speed computers, which can accept information much more rapidly than present equipment can feed it.

Mobile Radio Wants TV Channels

Mobile radio equipment manufacturer members of the Electronic Industries Association have petitioned the FCC for a hearing on releasing the frequencies covered by TV channels 14 and 15 for two-way mobile radio. They insist that overcrowding of present mobile radio channels is so great that the public interest would be better served if these channels were used for communications rather than for TV broadcasting. Telecasters, on the other hand, suggest that the request is singularly ill-timed, coming as it does on the heels of an act of Congress intended to permit better utilization of the ultra high frequencies, beginning at channel 14.

Brief briefs

US buyers spent more money on electronic products in 1962 than in 1961, says the EIA. TV sets and other consumer products jumped from $2.087 billion in '61 to $2.300 billion in '62. Tube, semiconductor and component sales, $2.108 billion in '61, reached a '62 total of $2.300 billion.

Moscow will get a third TV channel in 1963, says Soviet news agency Tass. The USSR has 123 stations, 250 satellites, serving 90 million people, Tass stated.

ETV will reach 90% of US population by 1972—so predicted John F. White, National Educational Television president, at the group's recent New York City meeting.

An electronic test-scoring machine developed by Electronics for Education, Inc., Kensington, Md., marks wrong answers on students' tests and prints the total on the page. Called the Grademaster, the device grades 150 answer sheets in 30 minutes—a 7½-hour task if done by hand.

The Japanese quota system for exports of radios with three or more transistors will continue through the first half of this year, says JMEA (Japanese Machinery Exporters Association). The group reports a steady increase in radio exports to all areas.

A Northwestern University athlete plays football wearing a triaxial accelerometer and a metal foil antenna inside his helmet. Attached to his shoulder pad is a 21-transistor FM multiplex radio transmitter that sends signals to a sideline receiving antenna. The equipment, made by Admiral Corp., gathers data for the manufacture of safer helmets. END

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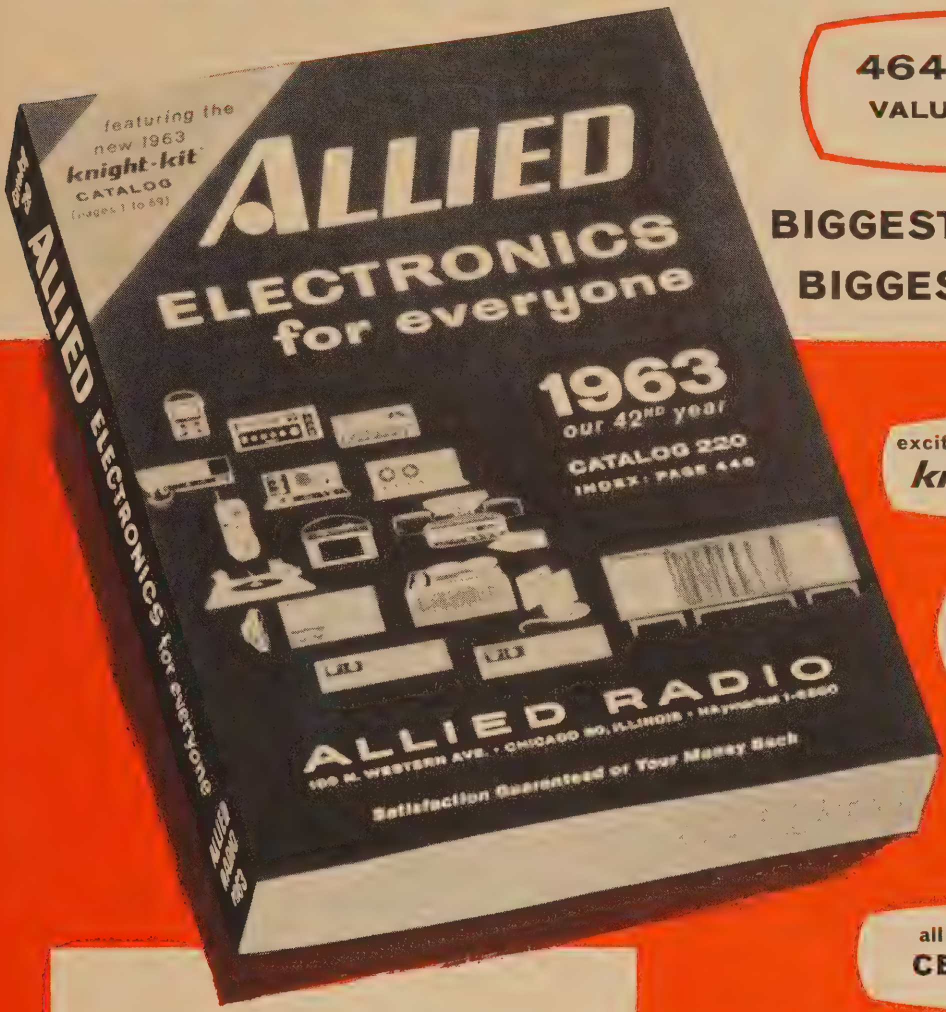
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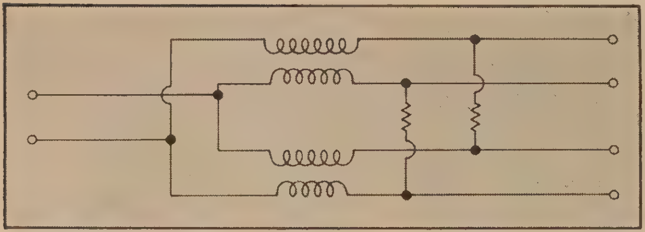
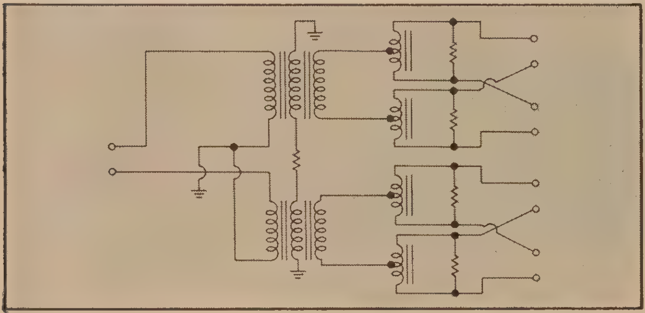
THE SECRET'S IN THE CIRCUIT

BLONDER-TONGUE TV/FM COUPLERS

You can't tell a coupler by its case. However, a view of what's inside can tell you why a coupler will deliver clean, interference-free signals to a multi-set installation. Examine the circuitry of Blonder-Tongue couplers. Compare them with ordinary units. It's easy to see why they are the best selling quality couplers on the market.





THE TIME TESTED BLONDER-TONGUE A-102

This is the champion performer among all 2-set couplers judged on the basis of its popularity with technicians and TV viewers. The A-102 offers 12 db isolation *with only 3 db insertion loss*—half the insertion loss of the average 2-set coupler! Designed for both TV and FM, it is especially effective in weak signal areas. For FM stereo, this low loss hybrid type unit is the answer. A look at its circuitry will tell you why. • patented bifilar transformers • backmatched for precise impedance match • heavy conductors end burnouts. List $3.20

NEW COLOR-ENGINEERED COLOR-4

Where a color TV set is one of the sets receiving signals from a single antenna, the Color-4 is the only answer. This super deluxe 4-set coupler offers maximum interset isolation (16 to 24 db), excellent impedance match and only a 6.5 db insertion loss. The Color-4 uses ferrite broadband transformers in balanced bridge design and it has a voltage standing wave ratio of less than 1.5. Result: Lower inherent insertion loss, less smear and ghosts, sharper pictures than any other 4-set coupler.

- Ferrite broadband transformers in balanced bridge design
- VSWR of outputs and inputs no greater than 1.5.
- Backmatched List $9.95

BLONDER-TONGUE TV & ANTENNA COUPLERS

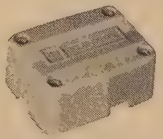
NEW BLONDER-TONGUE ALL CHANNEL SET-2. The SET-2 is one of the few couplers available today that can deliver full power signals to two UHF, or a VHF and UHF receivers operating from the same antenna. Effective straightforward resistive circuit provides 12 db interset isolation with 6 db loss. While it's effective on VHF and FM, the low loss A-102 is a better choice for FM stereo. List $3.20

BLONDER-TONGUE A-104 FOUR SET COUPLER. Inductive — resistive coupler for VHF and FM. Feeds 4 VHF receivers from one antenna, or mixes 4 antennas into one line. Isolation: 12-20 db. Loss: 7.5 db. List $4.50

BLONDER-TONGUE A-105-HI-LO COUPLER. Combines low and high band VHF antennas and provides separate low and high outputs from a common line or antenna. Less than 0.5 db loss. List $4.10

BLONDER-TONGUE A-107 UHF-VHF ANTENNA COUPLER. The choice in UHF areas throughout the country. It combines VHF and UHF antennas, or provides separate VHF and UHF outputs from a common line or antenna. Less than 1.0 db loss. List $4.75

INDOORS OR OUTDOOR. Blonder-Tongue couplers are the easiest to install. Patented stripless connectors assure rapid, positive installation—no stripping, no splicing twinlead. Weatherproof, *non-breakable* case permits installation indoor or outdoors.



For the right coupler at the right price, contact your Blonder-Tongue parts distributor or write Dept. RE-3

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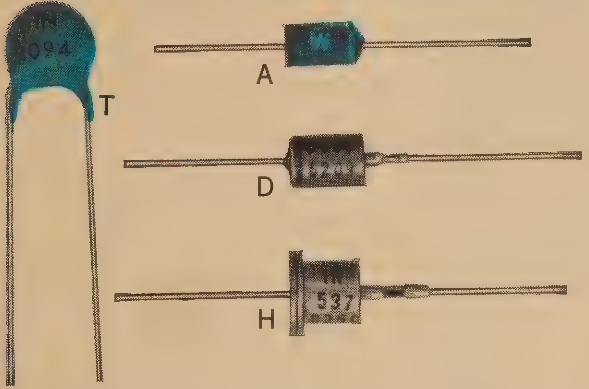
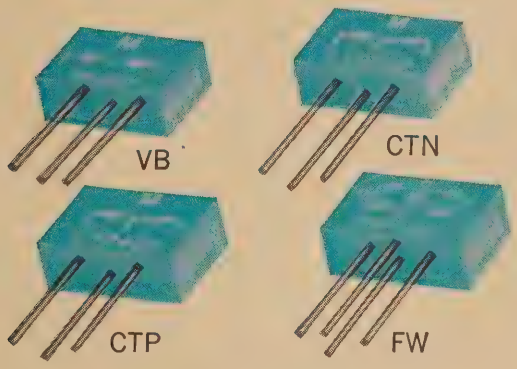
Time for a new look at silicon rectifiers



SILICON RECTIFIERS—750 ma @ +50°C

PRV	T	A	D	H
50	1N2090	A50	D50	1N536
100	1N2091	A100	D100	1N537
200	1N2092	1N2069	1N3193	1N538
300	1N2093	A300	D300	1N539
400	1N2094	1N2070	1N3194	1N540
500	1N2095	A400	D400	1N1095
600	1N2096	1N2071	1N3195	1N1096



PACKAGED RECTIFIER CIRCUITS

	750 ma @ +50°C			1.5 amp @ +50°C
PRV	VB	CTN	CTP	FW
50	VB50	CTN50	CTP50	FW50
100	VB100	CTN100	CTP100	FW100
200	VB200	CTN200	CTP200	FW200
300	VB300	CTN300	CTP300	FW300
400	VB400	CTN400	CTP400	FW400
500	VB500	CTN500	CTP500	FW500
600	VB600	CTN600	CTP600	FW600

The silicon rectifier industry moves at such a rapid pace that you may not be aware of some recent developments.

Take *hermetic sealing* for example. Many technicians feel that the "top hat" rectifier is the only safe one to use . . . probably because it's the original MIL type (1N536, etc.). This is the Mallory "H" type. It's a fine rectifier and we sell thousands of 'em. If you really *need* hermetic sealing, you should check the Mallory "D" series. It's smaller than the "H" and actually has *better characteristics* at a *lower price*.

But are you sure you really *need* hermetic sealing? The Mallory "A" series (axial leads) and "T" series (parallel leads) actually withstand *four times* the humidity cycling of the MIL test. They're both epoxy encapsulated and are available in all ratings up to 600 PRV at lower cost than either the "D" or "H". You shouldn't confuse the Mallory "A" or "T" rectifiers with those made by other people, though. No kidding, we use a *superior* encapsulating system. If you need *quality*, you'll be ahead with Mallory.

So, whenever you need 750 ma from 50 to 600 PRV, decide on the style and price that fit your requirements. Your Mallory Distributor has *exactly* the right rectifier for you.

Multi-rectifier circuits. Instead of hooking up a number of rectifiers to make a doubler, full-wave center-tap or full-wave bridge, you can now get Mallory *pre-packaged circuits*. Cost is less than that of separate rectifiers. And convenience and reliability are far greater, because you have fewer solder connections to make, fewer parts to stock and handle. We make them in ratings up to 600 PRV.

Reliability. Lots of people think "reliability" applies only to military electronics. But Mallory doesn't think so. We think the service technician needs reliable components, too. We'd like to say our silicon rectifiers were 99.99% reliable. But we can't. In order to quote 99.99%, one must have a *failure somewhere*. The fact is, that during 1962 we didn't have a *single* failure. Saying 100% reliability sounds like bragging . . . so we won't say it.

You might be interested to know that every single Mallory silicon rectifier gets a complete electrical check at *full* temperature and *full* load THREE SEPARATE TIMES. Time consuming? You bet! But there is absolutely no question about quality.

Mallory Silicon Rectifiers are available through your Franchised Mallory Distributor . . . see him for other Mallory products, too . . . batteries, capacitors, controls, switches, resistors and vibrators. In fact, see him for *all* of your electronic requirements.

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WINEGARD'S

RED HEAD

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Red Head has a lightning-protected circuit—no transistor burnout due to lightning flashes, static precipitation or power line surges. Built-in high pass filter rejects interference from Citizen's Band, hams, etc. Unlike other transistor amplifiers, it can't cause smear or graininess in picture from phase distortion . . . has linear frequency response, no suck-outs or roll-offs at end of bands. You get clear, bright picture detail on color and black and white.

OTHER ADVANTAGES OF WINEGARD'S RED HEAD—has newest type four-lead transistor . . . is AC powered, no corrosion at terminals, no polarity problems—has built-in 2-set coupler in power supply—mounts easily on antenna, mast or wall—powerful enough to drive 6 sets, can be remoted up to 1500 feet using 300 ohm twin lead or ladder line. New eye-catching bright red amplifier housing—gives lasting product identity.

Red Head is your *best* transistor antenna amplifier buy. Try a few and see for yourself. Write for technical data or ask your Winegard distributor.

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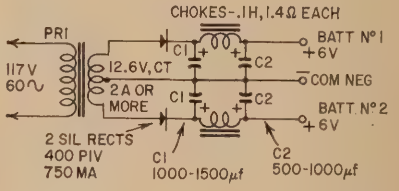
Correspondence

An Unusual Problem

Dear Editor:

I built the seven-station intercom featured in the June 1962 issue, page 50. It works like a charm—very sharp, very clear, very sensitive. Of all the electronic gadgets that I have built, this is the one I am most proud of.

So this is my problem: it works so good everybody's playing with it, and I'm always buying batteries for it.



Could you please send me a wiring diagram for a power supply to replace the two 6-volt batteries?

EDWARD KUTA

Chicago 39, Ill.

[Our Service Editor, Jack Darr, supplies the diagram above.—*Editor*]

Improving the Improved

Dear Editor:

In the September 1959 issue, J. C. Soukup had an article on a transistor "Improved Preamp" (page 132). I built it, using a 2N175 low-noise transistor and a 9-volt battery. Now, adding the "Tunnel Diode FM Tuner" described in the November, 1962 issue (page 37) the preamp adds enough "zip" to the tuner to make it quite usable with my hi-fi amplifier. A double-pole single-throw switch is used for the 1.3–9-volt battery combination. Very quiet—but A-OK!

J. T. WALSH

Stamford, Conn.

Letter Writers Only

S 1-16

Dear Editor:

I would like to have a pen friend in your States, preferably a graduate or post-graduate student in electronics or electrical engineering.

N. LO. K. NENI, IV B.E. (ELEC)
Garden House, near Engineering College, Anantapur, A.P., S. India

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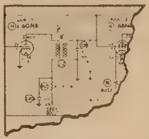

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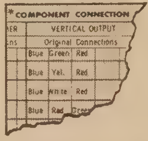
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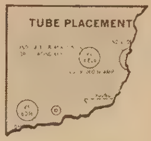
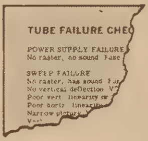
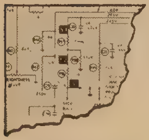
Field Servicing Notes spell out locations of adjustments for speedy "in home" servicing. Saves time spent in hunting for hidden adjustments.


TUBE PLACEMENT

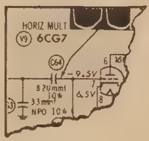
Tube Location Guide enables you to locate and replace proper tubes in seconds—a big time-saver on most repair jobs.


TUBE FAILURE CHE
POWER SUPPLY FAILURE
SWEEP FAILURE

Tube Failure Check Charts spell out probable tubes responsible for failure—no need to waste time studying circuitry.



Clear Parts Symbols with values and associated information are shown plainly on the schematic—no time wasted in cross-reference "look-up."


HORIZ MULT
V9 6CG7
C64
9.5V
6.5V
820mmf
33mmf
NPO 10%

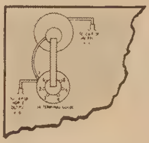
Waveform actual photos are shown on schematic for quick comparison of patterns on your scope. No time wasted in guesswork.

ALIGNMENT INSTR

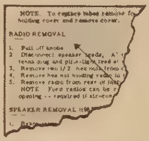
Unique Alignment System eliminates guessing; you get complete instructions with response curves, how to connect test equipment, proper adjustment sequence.

C14
C16
C17
C13
C10

Full Photo Coverage of the actual equipment makes identification of all components and wiring easy—you can *see* everything.



Terminal Identification saves you time; transformer and coil terminals quickly identified by color code or basing diagram shown on schematic.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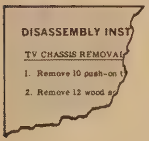
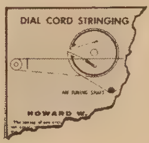
SPEAKER REMOVAL

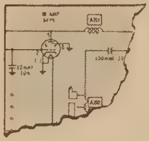
Auto Radio Removal instructions show you step-by-step procedure for removal of even the most complicated models—a big time-saver.


DISASSEMBLY INST
TV CHASSIS REMOVAL

Disassembly Instructions, step-by-step, help you remove difficult chassis, subchassis, and assemblies in minutes.


DIAL CORD STRINGING
HOWARD W.

Dial Cord Stringing instructions save you up to an hour or more of time and headaches on a single job.



Alternate Tuner Data—separate schematics, alignment data and parts lists are provided—no time wasted interpreting various tuner versions.

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Address__________

City__________Zone_____State_____

Checklist for buying a full-power CB 2-way radio

look for these features:

☐ **TRANSMITTER POWER** — For longest transmission range possible, choose a 5 watt unit, the maximum authorized power input for Class D CB radios.

☐ **SENSITIVITY**—A greater sensitivity rating indicates a better ability to reproduce weak signals. Look for a sensitivity rating below 1 microvolt to capture signals transmitted many miles away.

☐ **SELECTIVITY**—A radio's ability to reject interference from channels not tuned in, is largely determined by the type of circuit used: superregenerative, superheterodyne or dual-conversion superheterodyne. The latter circuit, the dual-conversion superheterodyne, is acknowledged by experts to be the best circuitry for clearest reception. Says Len Buckwalter, noted communications author, in *Electronics Illustrated* May 1962. ". . . Look for the dual-conversion feature if you wish to get top receiver performance."

☐ **CRYSTAL-CONTROLLED CHANNELS**—Fixed crystal controls assure accurate, fast communications contact. They enable users to switch quickly from one channel to another to contact different persons, to find a channel that isn't busy. It is best to choose a CB unit with multiple crystal-controlled channels for an efficient, flexible 2-way radio system.

☐ **POWER SUPPLY**—A power supply should be an integrated part of a CB radio. Since full-power CB radios are most often used in vehicles and base stations, a CB radio's power supply should be able to operate from both 12-volt auto battery and 110-volt AC line.

☐ **AUTOMATIC SQUELCH** — This automatically eliminates annoying background noise when a CB radio is on 'standby' (not transmitting and ready to receive any radio calls). Thus, hisses, crackles and other noises can't distract workers, drivers, etc.

☐ **AUTOMATIC NOISE LIMITER** — An effective automatic noise limiter is necessary, especially in heavily populated areas, to shut out extraneous interferences such as ignition noise. Makes messages more intelligible.

☐ **RELIABILITY** — CB radios must withstand vibration and shock which occurs during mobile use. Solid-state components—transistors and diodes—are less susceptible to damage than fragile tubes.

☐ **PORTABILITY** — Some full-power CB radios may be used in the field as portable units when equipped with a portable case-battery accessory. These units are generally lightweight, compactly designed and offer greater operating flexibility.

☐ **INSTALLATION** — Compact CB radios with simple mounting provisions don't steal leg room in vehicles, lower installation and maintenance costs.

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What Is a Conductor?

Dear Editor:

Referring to Mr. Miessner's letter in January RADIO-ELECTRONICS captioned "Conductors Opaque?", I suspect there is a problem in semantics. Maxwell's statement referred to conductors defined as those materials in which the E vector of an electromagnetic wave is zero. In Maxwell's terms, the opposite of a conductor was a dielecrtic. Except for superconducting materials, there are no perfect conductors, and the question is one of degree. A physicist generally considers that a material in which electric current is carried by the mechanism of free electrons approaches a perfect conductor. This includes most metals, and except for thin films where another set of rules must be used, metals are opaque.

Another way of looking at this is to consider the super-conductors which are perfect conductors and act as perfect barriers to electromagnetic radiation.

I hope this has defended the honor of Maxwell, who has suffered here, even as politicians today, from being quoted out of context.

L. CURTIS CALHOUN
Trenton, Ohio

Transistor-Safe Supply

Dear Editor:

I congratulate Mr. Bammel on a well written and informative article "Transistor-safe Power Supply" (January, page 32). I have a similar supply that has better filtering and greater current capabilities. I don't have the current cutoff feature . . .

I noticed what may have been an error in Mr. Bammel's circuit. The current-limiting control (R4) is a 10,000-ohm 2-watt wirewound potentiometer. At maximum resistance, the maximum current through it is 14 ma. It is underrated when the supply is delivering 100 ma. At high currents, the portion of the pot in the circuit is greatly overloaded. The resistance of this portion may become unstable, or burn out.

May I suggest substituting an Ohmite 12.5-watt miniature rheostat? It is not a 100-watter but it is certainly worth trying if the author can come up in his low-current limiting to 1,000 ohms.

FRED H. HORAN
Waltham, Mass.

Current Transformers

Dear Editor:

In Mr. Robert Middleton's article in the January 1963 issue (page 48) there is a statement that one can use a current transformer to put a current waveform on a scope.

Within the limitations imposed by the article, the statements are doubtless correct. But there are dangers that the uninitiated are not warned about.

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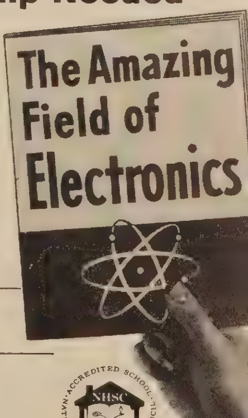

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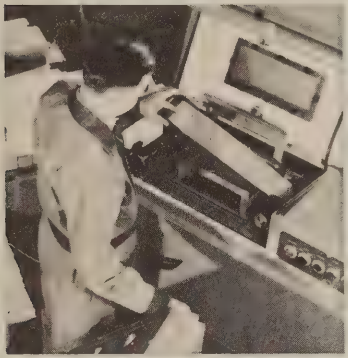

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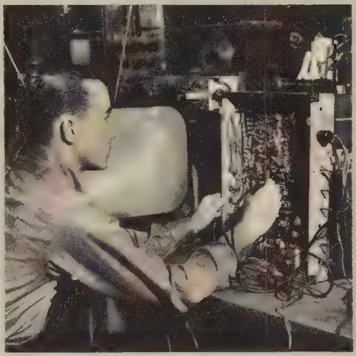

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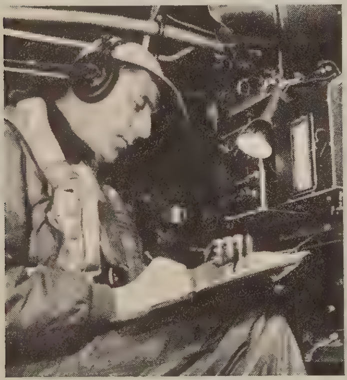

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To list two warnings about very real dangers—**1.** Do not close the magnetic loop in the ferrite "horseshoe." This would have the effect of making the transformer a true current transformer in which the secondary current ampere-turns is proportional to the primary ampere-turns. For example, in the illustration shown, if the primary current were 5 amps, the secondary current would be 2½ amps. Since the 2½ amps cannot pass through the input resistance of the scope, the voltage would increase to force it through. This could run the voltage up to thousands of volts.

2. Using a standard commercial current transformer could be even worse as the magnetic circuit would be heavier and would provide more power.

The answer is, of course, to use a high-wattage low resistance across the current transformer secondary to limit the voltage drop, and to warn the user not to close the magnetic gap. Also, to warn the user not to use standard commercial current transformers unless well loaded with resistance to bypass the current around the scope input, leaving only a very small voltage (1 volt is plenty) to be seen by the scope. After all, it is still the voltage the scope senses.

JOSEPH P. GUILFOYLE

Quincy, Mass.

[The letter above was sent to Mr. Middleton for his comments. Portions of his detailed reply follow.]

Dear Editor:

I fully expected that many readers would be arrested by the realization that current waveforms can be displayed on a scope screen without opening the circuit under test or making any connections to the circuit. That the statements are "*doubtless correct*" is witnessed by the fact that both Tektronix and Hewlett-Packard manufacture current probes for scopes. I use the Hewlett-Packard 456A probe in my own lab. It cost $150, and is worth much more in terms of time saved in checking current waveforms through a chassis.

Mr. Guilfoyle's confusion is obviously arguing on the basis of current transformers used in *power-generating stations* to feed low-impedance *ammeters*. As everyone knows, a substantial secondary current is drawn in this case, and the neophyte engineer is routinely warned not to open the secondary circuit while the heavy current is being drawn. It is the same type of warning given to students not to open the field circuit of an alternator abruptly while current is flowing. But it is incorrect to assume that because a power-house ammeter draws a heavy current, a scope will do likewise. It doesn't.

His suggestion of using a shunt resistance across the secondary is good—though not for the reason he cites. If we shunt resistance across the secondary, we damp out the spurious resonances considerably, so that more turns can be used than is otherwise possible. At best, we soon reach the next practical limit and have to use a secondary which is much smaller than could be desired. Long before we manage to get even 1 volt output, resonances in the large secondary winding start to develop excessive peaks in the frequency response which make the probe useless for scope waveform display.

In the nature of physics, a "standard commercial current transformer" *cannot* be shunted by resistance to adapt it for scope use. If someone maintains otherwise, let him try it. He will soon find himself up against the immutable laws of Nature.

I remember, back in the days when the screen-grid tube appeared, there was considerable confusion, simply because people could not quite understand the screen-grid action. Some of my friends simply could not conceive of a grid having no signal-control action—at least until after the smoke had cleared away. Probe transformers will be kicked around in much the same way no doubt, until people revise their thinking to square with the facts.

BOB MIDDLETON

Oxnard, Calif.

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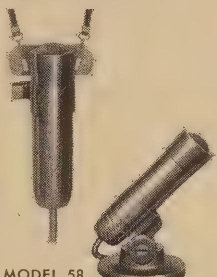

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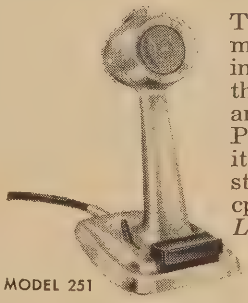

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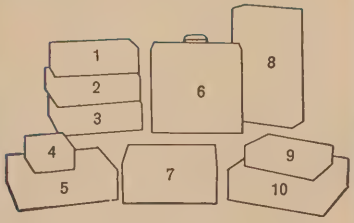

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Radio-Electronics
Hugo Gernsback, Editor-in-Chief

AUTOMATED ELECTRONIC NEWSPAPER

. . . The Radio-Newspaper Receiver Is Coming . . .

EVER since broadcasting began, radio (and later TV) have disseminated news *free* over the air.

In this electronic-automation age, physical newspapers, that must be printed at a central plant, then distributed by trucks to newsstands, or mailed or transported by rail or air to distant cities, are an anachronism. They are wholly unnecessary and economically suicidal.

Newspapers should be *completely* distributed via radio, so that readers have their paper—plus competing papers if desired—long before breakfast, even if the reader lives thousands of miles from the newspaper office. Snow, rain, storms would make no difference.

In the atomic age, *the instant newspaper* is a must, a practical necessity. The new method is called RAFAR (from **R**adio **A**utomated **F**acsimile **A**nd **R**eproduction).

Because of the constantly rising costs of labor and materials, few newspapers today are profitable. Witness the continuing death of newspapers in the US. In 1919, we had 2,078 daily newspapers, today there are only 1,761.

In the meanwhile, the country, plagued by frequent newspaper strikes, often has many strikebound newspaper plants, which for the time being are inactive and dead.

When *rafar*, the electronic newspaper, becomes a reality in the foreseeable future, the economic status of the newspaper will change radically. It will be able to pay higher wages than before, because the plant will have far fewer employees and far lower production costs.

Huge savings are possible by eliminating costly newspaper presses and their operation, electros, ink, paper, pressmen, trucks and trucking, the vast expense of physical newspaper distribution—to name only a few. Take only one item: paper. During the recent newspaper strike in New York, the nine dailies save $300,000 *a day* in newsprint cost! The publishers never make a profit on the sale of papers: the money they take in on newsstand copy sales just balances the cost of the newsprint. The profit, if any, comes from advertising space sold.

Under electronic rafar publishing, we retain the type compositors, linotypes and their operators (although special type machines will reproduce type directly on paper; actual metal type probably will no longer be needed), make-up men.

The next operation—instead of actual printing—will be photographing the completed page on film or special paper for facsimile radio transmission (A similar means is now used by *The New York Times* for its European edition.)

Every future newspaper at presstime will transmit its electronic "paper" via its own radio-facsimile station, preferably by FM because it will make for better readability.

Physically, the *rafarnews* as finally received in the reader's home will not differ much from today's newspaper. All features will remain exactly the same: text, pictures, advertisements—yes, it is even possible with more expensive future receiver models to transmit in color.

As projected on his home screen it will be the same size as a standard newspaper: 22½ x 15 inches. (It can be smaller if the particular newspaper projects in a tabloid size.)

Routinely from 2 to 4 am the regulation *rafar* edition begins its transmission. With modern, engineered speed-up facsimile equipment at the transmitter and receiver, it should take less than 1 hour to send and receive the entire paper—unless the edition runs over 100 pages. (Sunday magazines, and other non-news sections, even today, are completed Friday and earlier, hence can be radio-transmitted Saturday afternoon, or between 2 am and 8 am Sunday, after the main news section has been sent out.)

Here is the way the future *rafar receiver* will look. It will be a massproduced radio-facsimile projector. It will not be cheap at first because of its inherent complexity. Yet, if you figure the cost of buying the present-day physical newspaper for 365 days, this comes to about $44—for a *single* newspaper. If you add an afternoon paper, the cost (depending on locality) can come to $60 and more.

Such a rafar receiver can be built even today—no electronic breakthrough is required. With modern microminiaturization, the physical size of the actual receiver can be small.

The retail mass-produced price would probably come to $100 to $150 for a black-and-white receiver, more for the color set. But as the consumer saves from $44 to $60 a year in not buying newspapers, and as a large percentage of people buy on terms, it appears that there could be dozens of millions of rafar receivers in American homes in a few years.

Completely transistorized, the weight without the screen would be less than 15 lb, including the optical projector.

The rafarnews set must be turned "on" continuously. This calls for a standby electronic receptor device that is never turned off. Thus it can receive spot instant news "extras" at any hour of the day.

Before the incoming newspaper begins arriving at its destination, a special signal sent out by the newspaper office starts the facsimile-set recorder. The rafar "newspaper" is now being printed rapidly on a special paper roll. The size of the incoming page is reduced to about one-third; 7½ x 5 inches. This calls for a paper roll 7½ inches wide. The roll is operated automatically by a small motor which must be synchronized to the newspaper plant motor. The roll is synchronized by a special circuit similar to that which we use in TV picture transmission and reception. (You will not have to read this miniature newspaper! Read on!)

Today we have many techniques of facsimile recording, including crude carbon-copy means, heat processes, chemical recording and what engineers in the art term electrosensitive methods. Nor do we need paper. We can record on extra-thin transparent plastics, similar to cellophane or other materials.

To continue, it is obvious that you could not read with

(*Continued on page 74*)

(See page 74 for illustration of the rafar receiver)

Transistor Amplifier Boosts Vom Sensitivity

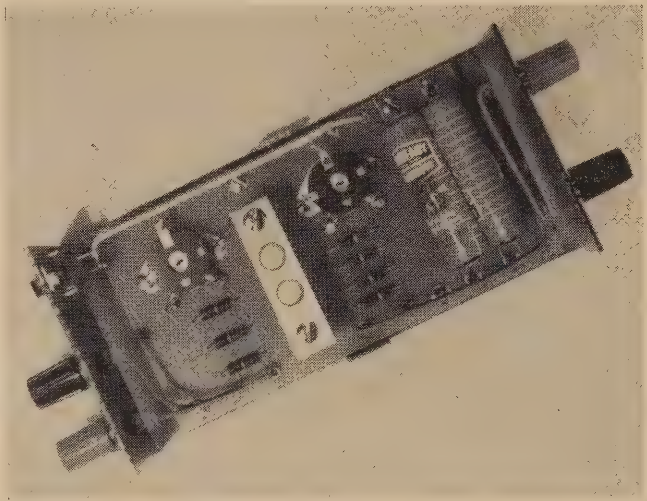
2-transistor circuit makes your vom into a millivolt and microammeter

By JOHN H. FASAL

CONSIDERING THE HIGH COST OF SENSITIVE meters—in particular, millivolt and microammeters—a simple adapter that increases the sensitivity of conventional volt and milliampere meters so that they can be used for measuring millivolts and microamperes is valuable. The unit consists of a well balanced push-pull dc amplifier designed for highest stability and lowest temperature dependence.

The adapter is designed for use with a conventional multimeter having a 3-volt full-scale low range with a resistance of 20,000 ohms per volt and a minimum current range of 60 μa with an internal resistance of approximately 4,000 ohms. It is powered by two penlight cells.

R1, R2—6,800 ohms
R3, R5—1,200 ohms
R4, R8—pot, 200 ohms
R6—220 ohms
R7, R9—2,200 ohms
All resistors ½-watt 5%
BATT—3 volts (two penlight cells in series)
J1, J2, J3, J4—3-way binding posts
S—spst pushbutton or spring-loaded slide switch
V1, V2—GT-20, GT-74, 2N104
Chassis (See Figs. 2 and 3)
Case (See Fig. 4)
Miscellaneous hardware



The completed meter amplifier.

A pair of clip leads connects the meter amplifier to the meter, and the test leads are connected to the amplifier input. The amplifier is ready for use at any time since neither stabilization nor warm up time is necessary.

A spring-loaded switch protects the batteries against unnecessary discharge—they are connected to the amplifier only during the short time a reading is made. Fig. 1 shows the whole circuit.

Test leads are connected to the bases of transistors V1 and V2. Two voltage dividers consisting of resistors R2, R3, R4 and R1, R5, R4, respectively, provide the necessary negative bias to the transistor bases.

The correct bias voltages are set by adjusting R4.

Resistor R6, connected between the two emitters in parallel and the positive supply, has a double function:

1. To minimize temperature dependence.*
2. To introduce an effective negative feedback which assures high operation stability and eliminates nonlinearity in the output characteristic by the

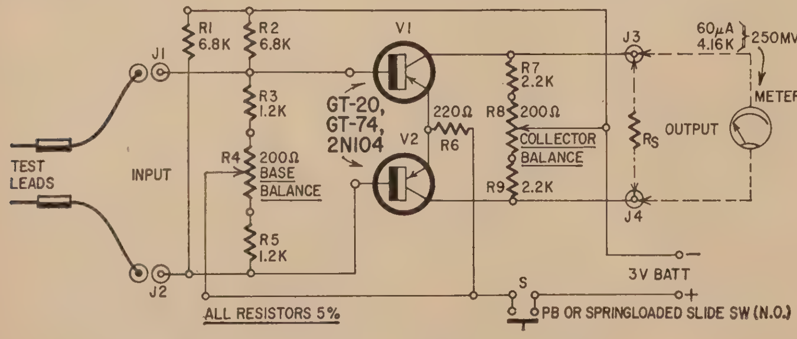


Fig. 1—Circuit of the simple little amplifier.

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* Perfect temperature compensation may be obtained by determining the emitter resistance as a function of the collector current. This method, verbally transmitted to me by Mr. S. Bagno, may be the subject of a future article and was applied in the present case. It gave surprisingly good results.

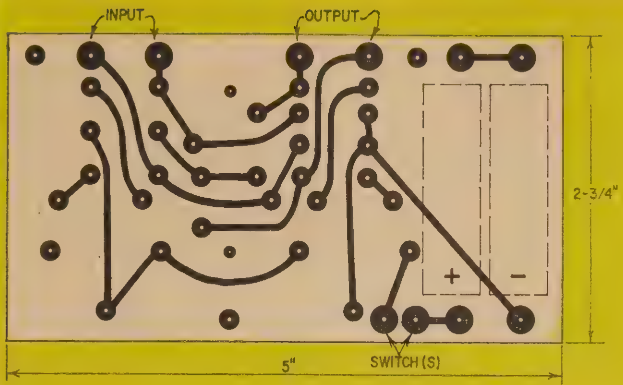


Fig. 2—This printed-circuit board is for the meter amplifier.

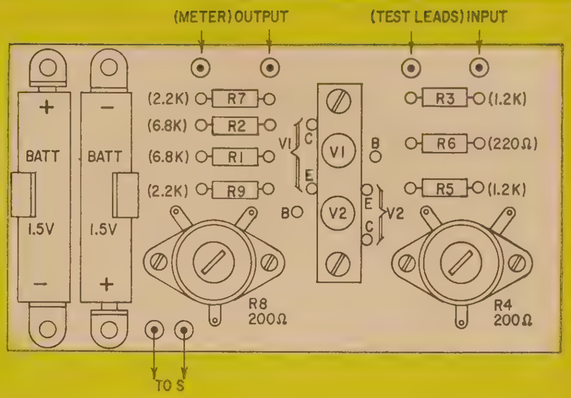


Fig. 3—Parts layout on the printed board. If you are not using a printed board, use the same layout on a perforated phenolic board.

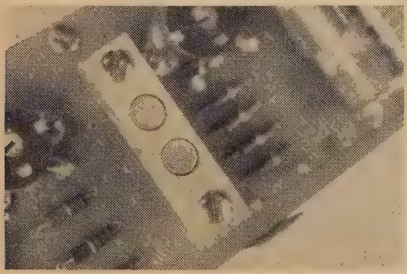
common-mode effect of a common-emitter resistance in a push-pull circuit.

The amplifier output is again conventional. The output voltage is taken across two symmetrical series resistors R7, R8 and R8, R9, connected between the collectors of V1 and V2 with return to the negative supply through the center tap. Since it is very difficult to get transistors perfectly matched, potentiometer R8 shifts the center point to the output circuit and in this way corrects small differences in the output balance.

This method has no disadvantages in general—but the unit has to be recalibrated if the input polarity is changed.

The spring-loaded normally open switch between the penlight batteries and the circuit is in the positive lead of the power source. Batteries should always be in good condition. Check them from time to time to make sure. Set up test jacks for this purpose on the outside of the case, near the switch.

To assure high stability of the zero-set (balance) and calibration, both transistors must be kept at exactly the same temperature. Temperature changes—as we will see later—do not affect the accuracy of the calibration and the balance as long as these changes affect both transistors simultaneously. For this reason the transistors are located on a common heat sink made from a brass bar (3/8 x 1/2 inch) and mounted on two standoffs on the board.



Closeup look at heat sink.

A printed circuit (Fig. 2) simplifies wiring. Of course there is no objection to conventional wiring. A simple method to simulate the arrangement of the printed circuit is to drill all holes and insert eyelets or Alden terminals on which all components are soldered and interconnected on the reverse side of the board (corresponding to Fig. 2) with insulated wire. The locations of all components on the board and all necessary polarities are given in Fig. 3. Potentiometers R4 and R8 are difficult to obtain. However, you can use Mallory type FL pots here. Run insulated leads from the pot to the printed board.

Fig. 4 illustrates an easy way to fabricate a simple and neat housing for the instrument by bending two aluminum sheets as shown. A U-shaped bracket eyeleted to the base serves as support for the two 4/40 mounting screws. Mount the terminals and the switch on the two small sides of the housing base. Insert grommets into the two holes on the cover. These holes face the potentiometer shafts, which are adjusted with a screwdriver passed through the holes. The printed board is fastened to the base of the housing with screws and 3/8-inch spacers. Fig. 5 shows the heat sink.

Balancing and calibration

Balancing: Connect a multimeter (range 60 μa/4,000 ohms) to the meter amplifier output, depress the pushbutton and adjust input potentiometer R4 (nearer the pushbutton) for meter zero.

During this first step the input terminals are *open*. Now short the input terminals and correct resulting unbalance by adjusting the output potentiometer R8. Should it be impossible to bring the meter back to zero, decrease the value of either R3 or R5 by shunting it with a higher resistance (5–20,000 ohms) to extend the range of R8.

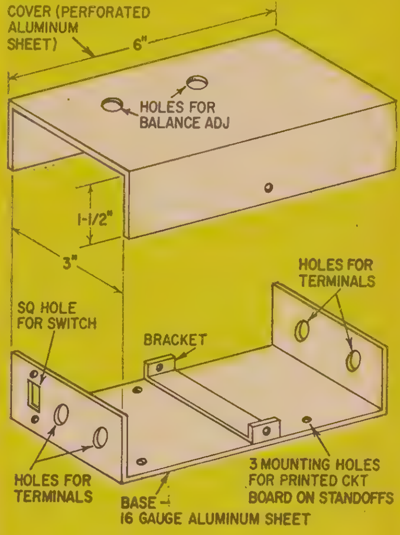

COVER (PERFORATED ALUMINUM SHEET)
6"
HOLES FOR BALANCE ADJ
1-1/2"
3"
HOLES FOR TERMINALS
SQ HOLE FOR SWITCH
BRACKET
HOLES FOR TERMINALS
BASE — 16 GAUGE ALUMINUM SHEET
3 MOUNTING HOLES FOR PRINTED CKT BOARD ON STANDOFFS

Fig. 4—Details of amplifier case.

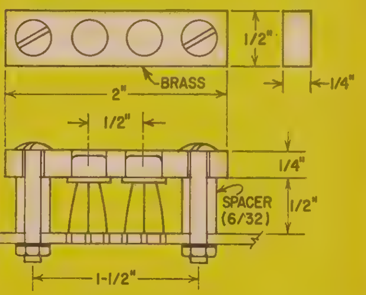


Fig. 5—Heat-sink detail. If you use any transistor other than GT-20 or GT-78, check case diameter before drilling heat sink. Cast must be a snug fit into heat sink.

Opening the input terminals will now result in an unbalance of much smaller degree. The correction is made by readjusting R4. Repeat the procedure of alternately shorting and opening the input terminals and readjusting the output and input potentiometers as often as necessary to get a perfect balance for both open and closed input terminals.

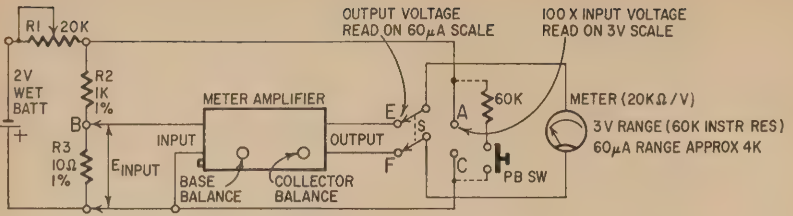


Fig. 6—Calibration setup with only voltmeter.

Calibration: The reference voltage is taken from a 2-volt wet battery connected to an adjustable voltage divider with low output impedance. This avoids a change in the calculated ratio of the voltage divider by shunting the output of the divider with the input of the amplifier. In our case the 10-ohm resistance of the voltage source will hardly be affected by the amplifier's relatively high input impedance about 1,000 ohms.

If only one voltmeter is available for the calibration, the arrangement shown in Fig. 6 is very useful. The multimeter can be used here for both input and output measurement. It is switched from one position to the other by a dpdt switch.

To compensate for the internal resistance of the meter (60,000 ohms), a 60,000-ohm resistor in series with the pushbutton may be connected in parallel to the points A-C in Fig. 6. Close this when the meter (60-μa range) is connected to the output.

A variable resistance of approximately 20,000 ohms determines the current through voltage divider R2 and R3 (Fig. 6). The input voltage taken across R3 will be very close to 1/100 of the voltage across R2 plus R3. It can be changed by adjusting R1 and can be measured for any setting of R1 with the voltmeter switched to terminals A and C. (Before switching from output to input, you must switch the meter from its 60-μa range to its 3-volt range.) The output voltage for these conditions can be found by switching the voltmeter to output terminals E and F.

The amplifier is linear for all inputs from zero to 13 mv and outputs from zero to 60-μa. Therefore, we can calculate the constant ratio between output and input and multiply the reading on the meter's microampere scale by the calculated multiplier to get the measured voltage in millivolts. Since 60-μa output corresponds to 13-mv input, the multiplier is therefore 13 mv divided by 60 μa or 0.216 mv/μa. If the output reading is 50 μa, the measured input was 50 × 0.216 = 10.8 mv. It would be much simpler if the multiplier were a whole number.

To make this possible, adjust emitter resistor R6 so that, for instance, output for 60 μa (full scale of the highest meter sensitivity) is not 13 but 12 mv. This signifies a small loss in sensitivity but makes the multiplier 0.2 instead of 0.216.

The load resistor in the output of the circuit is the internal resistance of the 60-μa meter range—approximately 4,000 ohms. Increasing the load resistance by using, for instance, the 3-volt meter range (3 volts × 20,000 ohms/v, or 60,000 ohms) means that amplification is increased at the expense of non-linear output and a less sensitivity.

You may want sometime to use the meter amplifier with a meter other than the one mentioned. This can be done if the calibration is established point by point and a conversion scale is made. This consists of two superposed scales, the right side refers to the meter reading shown as the linear scale and the left side corresponds to the input values. (If 20 mv corresponds to 0.75-volt output, the 20-mv mark for the input voltage must be opposite the 0.75-volt mark of the output voltage.)

The meter amplifier has been tested at different temperatures, and temperature compensation was found excellent for normal operating conditions. A variation between 50 and 90° F changes the calibration for a 6-mv input (output 27μa) less than ±5%. No significant aberrations from the calibration are expected between 45 and 70°F.)

Current measurement

The use of the meter amplifier is not restricted to measuring small dc voltages. It can be used in the same way for low current measurements.

Since the input resistance is in the order of 2,000 ohms per volt, and the usable input voltage covers a range from 0 to 12 mv, the current flowing through the input resistance will vary between 0 and $\frac{12 \times 10^{-3}}{2 \times 10^{3}} = 6$ μa. Therefore, the input of the meter amplifier is similar to the input of a microammeter with a range from 0 to 6 μa and an internal resistance of 2,000 ohms.

Ac measurement

The meter amplifier as it was described is designed for use on dc only. However, it is possible to extend its use for ac, provided the probe used permits the detection of small ac voltages. END

Electronic Music

A strange electronic organ made up of 13 tape recorders got its first showing at an exhibit of electronic gadgets dreamed up by students of the Technical University at Delft, Holland. Each recorder produces a different tone, set off by one of the 13 corresponding keys. A one-octave melody can be played on the instrument.

The idea suggests using tapes prerecorded with characteristic organpipe tone qualities, and operated from a manual, to stimulate actual pipe organs electronically.

World Wide

Some tips for the novice broadcast engineer

Setting up for remote broadcasts

By JACK DARR
SERVICE EDITOR

ONE OF THE FIRST ASSIGNMENTS A RADIO station's junior engineer is bound to get is a remote broadcast. Junior engineers draw these assignments like honey draws bees! And they offer those recent engineering school graduates who have a good theoretical grounding, but haven't had a chance to get practical experience, several opportunities to do things wrong.

Many little hints and kinks have been worked out by those of us who have banged around the business for a few years. They are offered here in the hope that they may ease the load on the novice. In case you've been working in the field for quite some time, you might read this anyhow: you just *might* learn something—never can tell!

The typical remote broadcast is made from locations such as a church, fair, athletic event, public gathering of some kind or even a store window. The facilities are often pretty primitive, so the first things you should do are learn how much equipment to take along and get some idea of the difficulties you're likely to run into.

Remote broadcasting requires a remote amplifier, known simply as "the remote." It includes a small audio amplifier, VU meter and provisions for up to four microphones, headphones for monitoring, and so on. Older models are ac-powered. Some new ones are self-contained—with battery-powered transistor amplifiers.

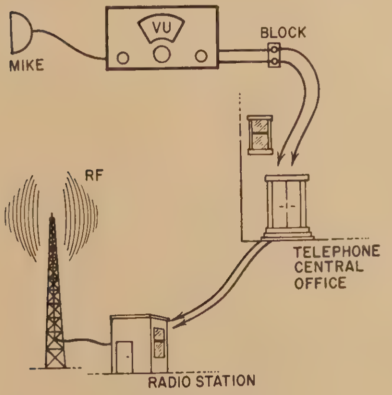


Fig. 1—Block diagram shows how remote connects to the radio station through the telephone company lines.

The equipment is hooked up as shown in Fig. 1. To connect the remote to the radio station, a "pair" of telephone wires is leased from the phone company. The linemen run wires to the site from the nearest telephone cable, and terminate them in a block. The radio engineer connects the remote to this. The telephone wires are called a loop. They run from the site, to the telephone office, through a special part of the switchboard (not the part which carries the regular telephone calls) and out to the radio station. Standard practice seems to be for the telephone company to run about a 10-pair cable out to the radio station. This is terminated at a block inside the transmitter house or studio, near the audio console. From here, shielded pairs of wires are run to a jack panel or patch panel, a part of the transmitter's audio equipment. Fig. 2 shows a typical patch panel, and the patch cords used with it.

One photo shows a typical audio console of the type used in many radio stations. At the upper right side of the panel is a row of 10 pushbuttons. They control the 10 jacks in the patch panel on the wall at the right of the console. For normal broadcasting from a remote, the operator simply pushes the button connected with that line and throws the switch below to remote.

For example, several of the pairs here may be permanently connected to remotes—for example, a church which broadcasts morning services every Sunday. This would have its own line, left connected all the time, so that the operator would simply push the button. For the others, there will always be open lines. For our remote, the wire chief at the telephone company calls the station's chief engineer and says, "This remote will be on 4," meaning that he is going to connect our loop to cable pair No. 4 on the station terminal board. So, when the program begins, the station operator pushes button No. 4 and the remote program is on the air.

Now let's go back to the church with the regular broadcast. The portable remote amplifier can be replaced with an inexpensive fixed amplifier. It is stowed in an out-of-the-way place, turned on, and left there. A microphone is left on the pulpit.

The setup does not have to be elaborate—many radio stations use the small 7- to 10-watt kit amplifiers. They are unattended during the broadcast. The station engineer checks them at regular intervals by simply turning on the remote at the station console and listening to his monitor. The gain is fixed. Many engineers, when building the kit amplifiers, replace the regular

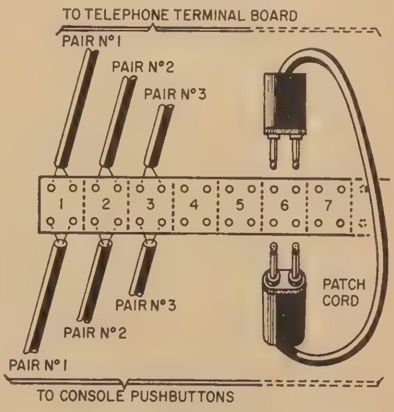
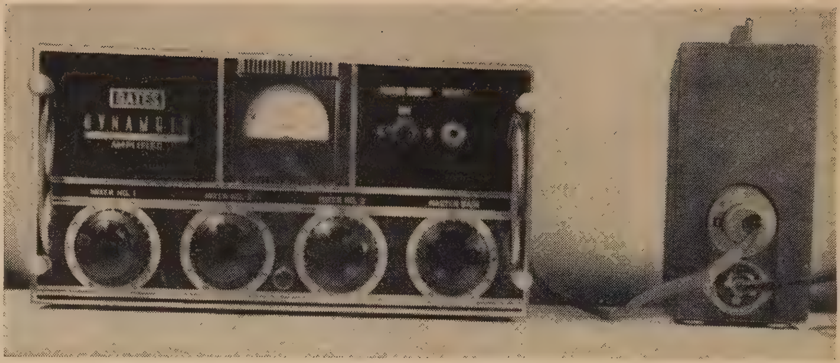
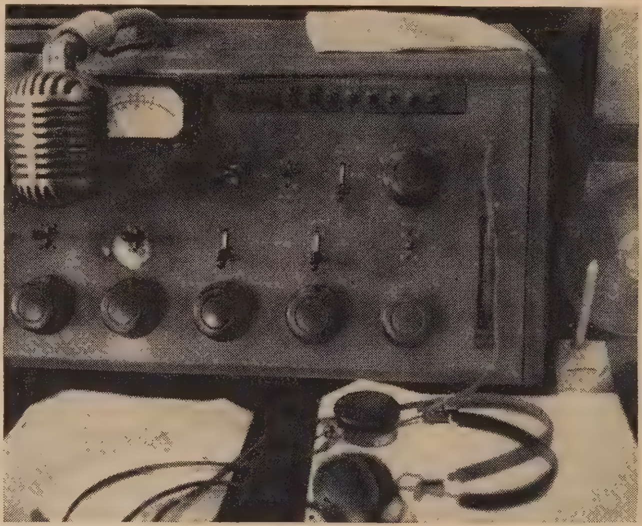


Fig. 2—Patch panel with three connections shown. Others are duplicates. Any line can be transferred to any other by plugging patch cord into top of one and bottom of other. Top terminals are connected to telephone terminal board, bottom ones to console pushbuttons.



Typical ac-powered remote. Ac power supply at right is on end of long cable to keep hum away from sensitive input transformers.



Remote end of small console. Ten pushbuttons at upper right select remote lines. Switches between VU meter and master gain pot select program or talk-back functions.

gain control with a locking type screwdriver potentiometer. Once it is set and the locknut tightened, no one can change it accidentally.

When the amplifier is left on all the time, tube life is usually longer than when it is turned on and off for each broadcast! Now, by simply pushing the right button on the console, the engineer can easily tell if the amplifier is working—the mike will pick up enough street noises, people moving about, cleaning up, etc, to let him know how things are going. With little practice, you'll be able to distinguish the characteristic sound of a live mike from the line-sing which would be all you'd hear if the amplifier were dead.

Checking out the loop

After you get to the remote site, the first job is to find the telephone wires and the block. Sometimes they are pretty well hidden, but will usually be within 20 or 30 feet of the place where you'll set up the remote amplifier. Connect the amplifier to the block, turn it on, and call the station. You do this by turning the gain up on one of the mikes and calling the engineer on the board (console). He should be waiting for your call, with the remote line connected to the monitor, and he will be able to hear you testing.

Phones are plugged into the jack on the remote amplifier—they're connected across the phone loop. So by throwing the switch on the console to talkback, the station engineer can talk to you over the same loop. This switching is all done at the station, you can't do any of it at the remote. Talkback works only on local loops, where the signals go directly to the station without passing through any of the telephone company's repeater amplifiers. Since these are one-way amplifiers, you can't talk back from the output to the input without some switching. You run into this on out-of-town broadcasts. However, in town you can always talk directly to the station and cue the program that way.

How to cue

The cue is very important in remote work. You want to hear the station announcer so you can turn the gain up at the right time to get your announcer on. Also, he must have some kind of cue so he'll start talking when he should. (Incidentally, *never* let your announcer do his own cuing. Too many of them have a habit of yelling into a mike, "Are we on? Are we on? Hello! Hello! One, two; one, two.")

This almost *inevitably* gets out on the air and is a very embarassing way to start a remote broadcast! So, *you* listen to the cues and tell your announcer *when* to start talking by the familiar pointing-finger signal. Hold your hand up above your head when you hear the station begin its description of the remote broadcast. (If the announcer isn't watching you, throw something at him!) When the station announcer says, "We take you now to ————, for the game between ———— —— and ————," bring your hand down so your finger is pointing directly at him, and he starts talking.

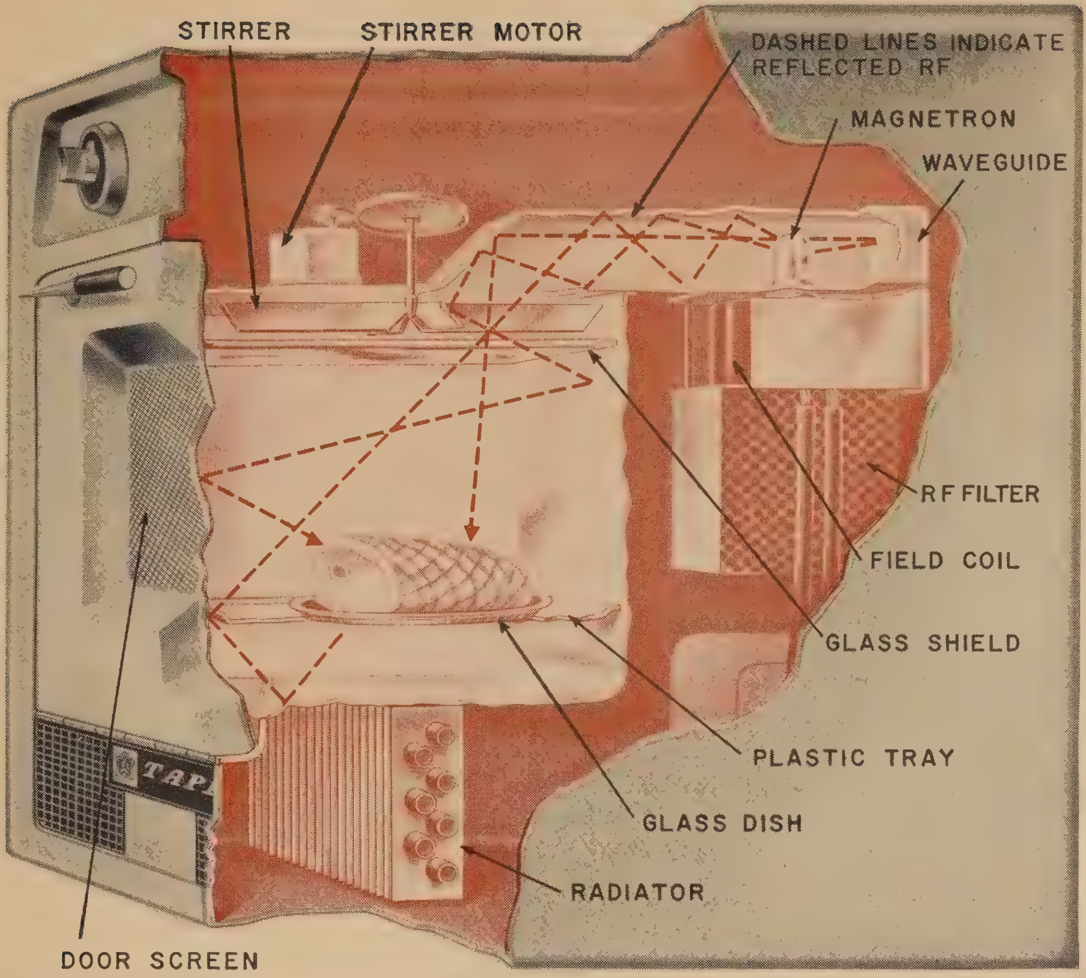
There are several ways of cuing a remote. The one just given is the easiest. Another way, not too popular with station managers since it doubles the expense, is to lease two loops—one for the broadcast, the other for nothing but cuing and talking back and forth between remote and station. This does have one big advantage—if anything goes wrong with the phone loop during the broadcast, you can connect the program line to the cue line and keep the show on the air.

A very simple method of cuing local remotes has been used since the development of the tiny transistor shirt-pocket radios. If you're within listening range of the station, you can tune in the program, set up your mike gain controls, and listen to the station announcer! When he says, "We take you now—" give the announcer the signal, and away you go. END

Electric Switching Error Puts Town In Reverse

Needles at a hosiery mill in Valdese, N. C., suddenly started to operate backward, unknitting the socks they had been working on. At the same time, conveyor belts in the city reversed, bringing the goods back to the makers instead of out to the waiting trucks. Worst of all, forced drafts from boilers blew down through the furnaces instead of up through the stacks, sending flame and gasses out into the factories. According to the power company spokesman, the incident was caused by a phase reversal in a 44,000-volt feeder, which reversed all 3-phase equipment. The trouble was found and corrected almost immediately, though there was a short interval during which there was no power at all.

Fortunately for the ordinary resident, the trouble was confined to the three-phase lines. The single-phase motors that operate ordinary small electric appliances were not affected, so vacuum cleaners and sewing machines still ran in the right direction.


STIRRER
STIRRER MOTOR
DASHED LINES INDICATE REFLECTED RF
MAGNETRON
WAVEGUIDE
RF FILTER
FIELD COIL
GLASS SHIELD
PLASTIC TRAY
GLASS DISH
RADIATOR
DOOR SCREEN
TAPPAN

electronic range in the home

Microwave cooking for the housewife's
kitchen—this unit makes it practical

By JOHN POTTER SHIELDS

MICROWAVE HEATING IS NOW BEING applied to domestic food preparation. The Tappan Co. is producing an electronic cooking range which has the same general outward appearance and is approximately the same size as the very popular "built-ins." It offers the homemaker:

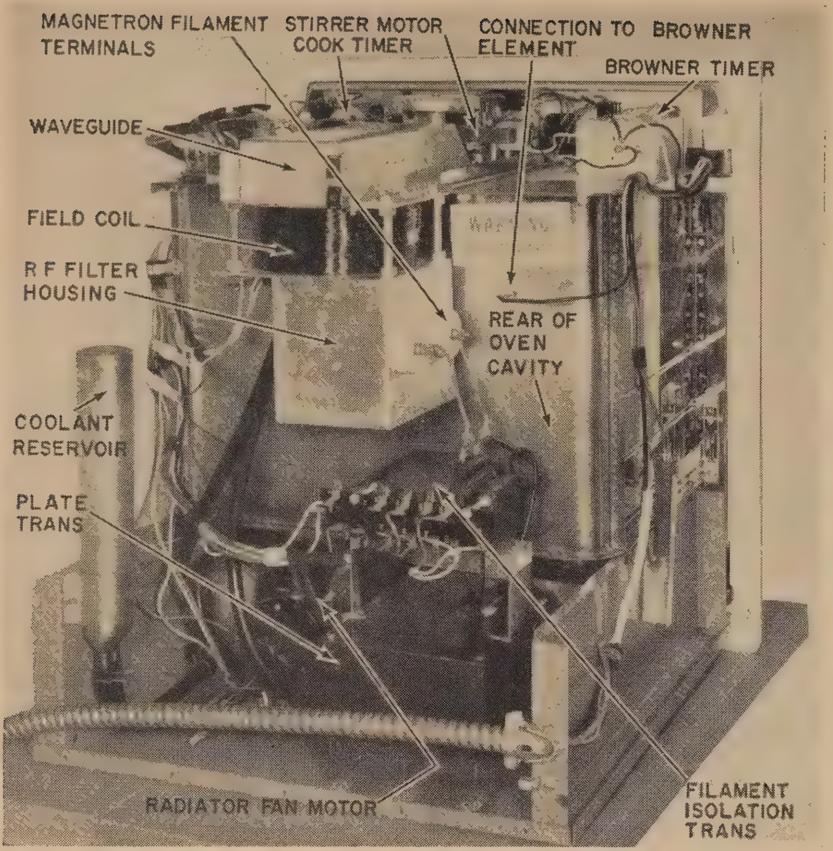
1. Extreme cooking speed—a baked potato can be "baked" in 4 minutes, a 5-pound roast in 30 minutes.
2. Cooking utensils (they can be glass or ceramic serving dishes) remain comparatively cool as the heat is generated within the food.
3. Easy cleaning as the smooth oven "cavity" remains cool during cooking, avoiding the problem of baked-on grease.
4. A much cooler kitchen (no heat is radiated from hot oven walls) coupled with a much shorter cooking time.

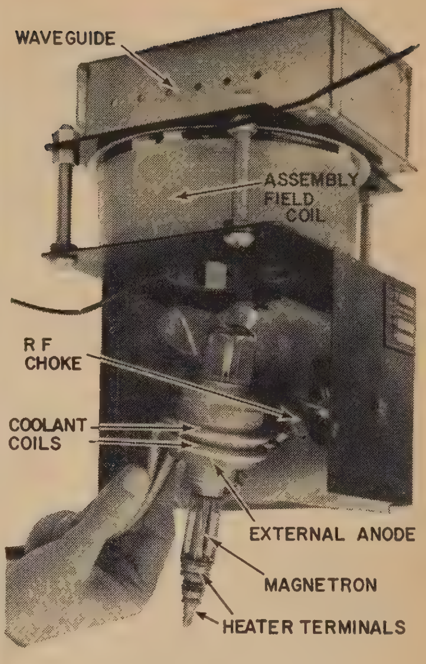
The diagram shows the circuit of the model R-4 electronic range. Its heart is a L3189 magnetron, operated as a grounded-plate, self-rectifying oscillator with approximately 6,600 volts at 300 ma supplied by T1. Operation with the magnetron's anode grounded and its cathode at a high negative potential simplifies insulation problems. Coil L3, which spirals the electron stream generated in the magnetron, thus establishing oscillation, receives its operating current from two sources. The first is a full-wave power supply consisting of an isolation transformer (part of T2), silicon diodes D1 and D2, dropping resistors R1, R2 and R3, and filter capacitor C1. The second is the magnetron's anode current return path to ground which flows through 10-ohm meter resistor R4 and the field coil.

The anode current flow through the field coil serves as a form of "negative feedback" which tends to stabilize

Closeup of the range and its operating controls.

HI-LO SW
ON-OFF SW
BROWNER TIMER
COOK TIMER
TAPPAN


MAGNETRON FILAMENT TERMINALS
STIRRER MOTOR COOK TIMER
CONNECTION TO BROWNER ELEMENT
BROWNER TIMER
WAVEGUIDE
FIELD COIL
R F FILTER HOUSING
REAR OF OVEN CAVITY
COOLANT RESERVOIR
PLATE TRANS
RADIATOR FAN MOTOR
FILAMENT ISOLATION TRANS


WAVEGUIDE
ASSEMBLY FIELD COIL
R F CHOKE
COOLANT COILS
EXTERNAL ANODE
MAGNETRON
HEATER TERMINALS

Litton Industries

Details of magnetron section, shown in position it occupies in equipment.

At first glance you'd never believe this device was intended to cook your supper.

the magnetron's plate current with changes in line voltage. As the magnetron draws more anode current, field current also increases tending to reduce the anode current. (A magnetron's anode current is inversely proportional to the magnetic field surrounding it.)

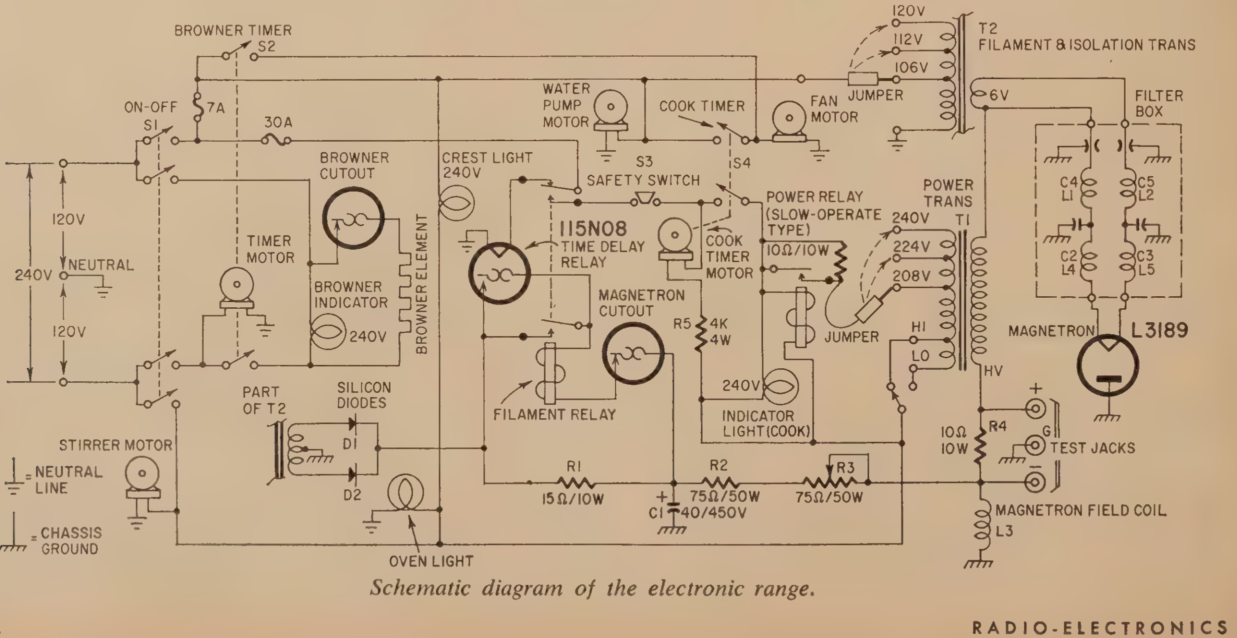
The magnetron and plate transformer are water-cooled. Water is circulated by a small centrifugal pump through a copper cooling coil wound over the magnetron's anode assembly and through a copper coil wound between the plate transformer's primary and secondary windings. The heat absorbed is dissipated by a small radiator located just behind a decorative grill on the lower front of the oven. Cooling air for the radiator is supplied by a small fan behind the radiator.

The microwave energy developed by the magnetron is coupled to the top of the oven cavity by a short length of rectangular waveguide. A motor-driven stirrer mounted directly beneath the mouth of the waveguide distributes the microwave energy evenly in the oven cavity, avoiding hot spots. This is done by changing the cavity dimensions, thus breaking up the standing-wave pattern.

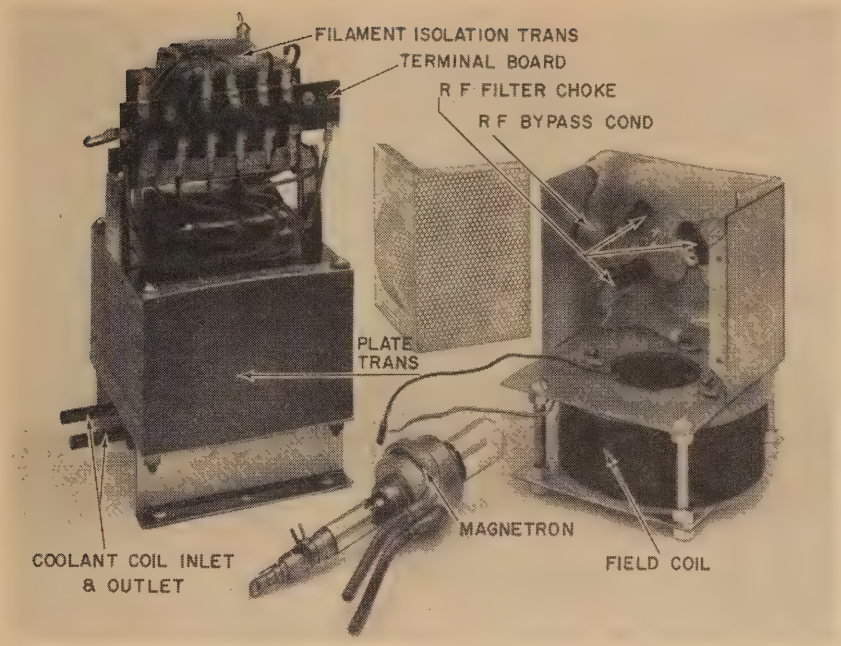
A filter box containing four rf bypass capacitors (C2, C3, C4, and C5) and four rf chokes (L1, L2, L4 and L5) eliminates spurious radio and TV interference emanating from the magnetron's cathode.

As the cathode temperature of a magnetron is somewhat critical, filament transformer T2 has three primary taps —120, 112, and 106 volts. Any one may be selected to match the prevailing line voltage at the installation site. Plate transformer T1 also has suitable compensating taps.

Since the magnetron's heater re-


BROWNER TIMER
S2
120V
112V
106V
T2
FILAMENT & ISOLATION TRANS
ON-OFF
S1
7A
30A
WATER PUMP MOTOR
COOK TIMER
FAN MOTOR
JUMPER
6V
FILTER BOX
BROWNER CUTOUT
CREST LIGHT 240V
S3
SAFETY SWITCH
S4
POWER RELAY (SLOW-OPERATE TYPE)
POWER TRANS
T1
240V
224V
208V
C4
L1
C5
L2
C2
L4
C3
L5
120V
240V
NEUTRAL
120V
TIMER MOTOR
BROWNER INDICATOR
240V
BROWNER ELEMENT
115N08
TIME DELAY RELAY
COOK TIMER MOTOR
10Ω/10W
MAGNETRON CUTOUT
R5
4K
4W
JUMPER
HI
LO
MAGNETRON
L3189
HV
240V
INDICATOR LIGHT (COOK)
FILAMENT RELAY
PART OF T2
SILICON DIODES
D1
D2
STIRRER MOTOR
= NEUTRAL LINE
= CHASSIS GROUND
R1
15Ω/10W
R2
75Ω/50W
R3
75Ω/50W
C1
40/450V
10Ω
10W
R4
+
G
−
TEST JACKS
MAGNETRON FIELD COIL
L3
OVEN LIGHT

Schematic diagram of the electronic range.



The magnetron assembly and its power transformers.

quires a 6-second warmup, a thermal time-delay relay delays the application of plate voltage until the heater has reached its proper operating temperature.

A high speed 220-volt browning element is provided for quick browning of meats, breads, etc.

How it works

When ON–OFF switch S1 is turned on, 120 volts ac is applied to T2's primary, the water pump, fan motor, oven-indicator light, stirrer motor and to the heater of the time-delay relay through the upper set of normally closed contacts on the filament relay. When the time-delay relay contacts close, the filament relay is energized by the voltage drop across R1. The relay's lower set of contacts close; bypassing the delay relay's contacts, and now supply power through S3 and S4 to the primary of the plate transformer. If 240 volts is applied directly to T1's primary, it would produce a transient of around 400 amps lasting about 2 msec. This surge could not be handled by the switches and other components through which it passes. The 10-ohm 10-watt resistor is inserted in series with one side of the primary to limit the transient to around 8 amps. The power relay closes about 15 msec later and shorts out the resistor to permit primary current to rise to its normal 24-amp level without transients. A 4,000-ohm resistor, R5, is connected in series with the cooking timer motor, which is designed for 117-volt operation.

The magnetron cutout, consisting of a thermostatic switch clamped to the outlet pipe of the magnetron's cooling coil, is connected in series with the filament relay coil. If the magnetron's coolant temperature rises above 180°F, the cutout opens, removing power from the filament relay. It, in turn, will interrupt current supplied to the plate transformer primary.

The BROWNING ELEMENT is connected directly across the 220-volt circuit through the contacts of the BROWNER TIMER and BROWNER CUTOUT switch. It is a straight resistance element, and heats the surface of the food being cooked. Foods that heat quickly, like steaks or chops, will not brown by microwaves. The browner also helps to crust a cake layer for easy icing. Something like a roast or whole chicken does not need additional browning. The BROWNER CUTOUT removes power from the element should the temperature at the top of the oven cavity exceed 170°F. This also prevents misguided persons from trying to use the browner as a broiler.

Tip jacks are located behind the removable control panel on the front of the range so a meter can be connected into the circuit to determine either magnetron plate current or field-coil voltage. When an 0–500-ma meter is connected across R4 (jacks "+" and "−"), it will indicate magnetron plate current. An 0–100-volt meter may be connected between the minus jack and ground to indicate the field-coil voltage.

That's the story on the electronic range. It's certain that you will be hearing more about this revolutionary method of food preparation. END

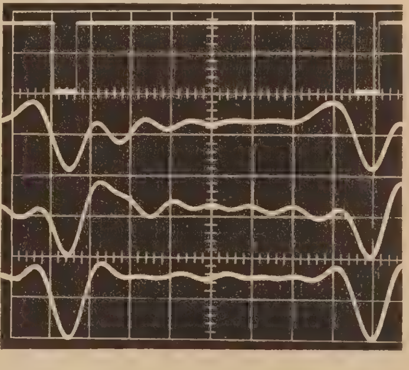
New Techniques Speed Information Transmission

Computer data, at the rate of 20 million bits per second (33 million words per minute), were flashed over a 40-mile experimental high-quality television link between Yorktown Heights and Harriman, N. Y., by International Business Machines Corp. engineers, under the direction of Dr. Emil Hopner.

The rate compares with 75 bits per second for ordinary telegraph, and 2,400 bits per second by telephone. Television channels are necessary for the extreme speed of 20 million bits per second, although data has been transmitted up to 8,000 bits per second over an experimental high-quality telephone line.

A very simple technique doubles the capacity of the channel. Since the only signals sent are binary digits (ones and zeros, dots and dashes, long and short spaces, etc., all fall into this classification), it is necessary for the receiver to distinguish only two signals. Duplicate receivers are set up. One of them is interested only in the polarity of the received signal, the other only in its amplitude. For one of these receivers, the "1" is a positive pulse, the "0" a negative one. The amplitude does not interest the receiver. The other receiver pays attention only to amplitude, and interprets a signal with an amplitude of 1 unit as a "0", and one with an amplitude of 2 units as a "1". Each transmitted bit therefore contains *two* bits of information—either two sequential bits in the same message, or two entirely different messages can be sent simultaneously. Thus a 10-million-bit channel can be fooled into transmitting 20 million bits of information.

The second technique is probably more novel and ingenious. The received signal is subject to distortion, especially over telephone lines. Compensating circuits in the receiver have been used in the past to reduce the effect of this distortion. This system puts the distortion correction in the transmitter. After a test run of known signals, the receiver station flashes the message back to the transmitter, detailing the exact type and quantity of distortion received. The received signal is then predistorted in the correct amount in the opposite direction, with the result that the transmission line itself acts as a correcting network. The photo shows, at the top, the square-wave pattern fed into the transmitting equipment. Under it is the distorted output from the receiver. The third figure shows the predistorted input pulse that produces an almost perfect pulse in the receiver (bottom of figure).



COVER STORY

By ROBERT F. SCOTT
TECHNICAL EDITOR

Selective Calling IMPROVES CB Operation

POWER
CALL
TONE SQUELCH
MON ALL
SELECTOR
CALL
HEATHKIT

Front view of Heathkit GD-162 Tone Squelch—a selective-calling system and tone-operated squelch.

THERE ARE A NUMBER OF NEW ACCESSORIES that can improve the efficiency of a Citizens-band station. A selective-calling system is one of the most useful of these. In a future article we will describe an unusual remote antenna amplifier and an automatic noise limiter and squelch.

The Heathkit Tone Squelch is a combined squelch and selective-calling system that uses one of four preselected tones to alert the desired station without opening the squelch of the other stations in the net. The operator at the station being called is alerted by the tone from the speaker, by a lighted indicator lamp on the Tone Squelch panel and by an auxiliary alarm such as a bell, buzzer or automobile horn.

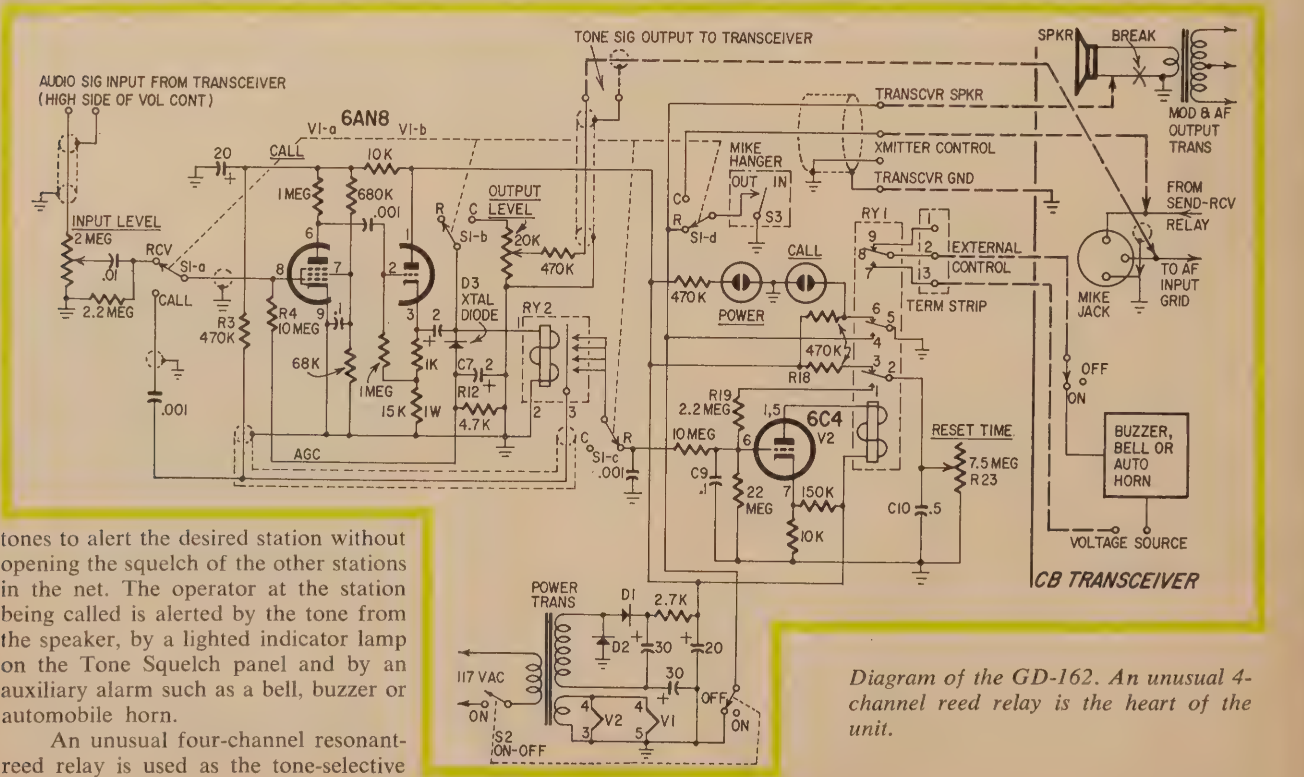

TONE SIG OUTPUT TO TRANSCEIVER
AUDIO SIG INPUT FROM TRANSCEIVER (HIGH SIDE OF VOL CONT)
6AN8
V1-a
V1-b
CALL
INPUT LEVEL 2 MEG
RCV
S1-a
CALL
2.2 MEG
R3 470K
R4 10 MEG
1 MEG
680K
10K
OUTPUT LEVEL
20K
470K
S1-b
D3 XTAL DIODE
RY 2
C7
R12 4.7K
AGC
S1-c
MIKE HANGER
OUT IN
S3
S1-d
TRANSCVR SPKR
XMITTER CONTROL
TRANSCVR GND
RY 1
EXTERNAL CONTROL
TERM STRIP
CALL
POWER
R18
R19 2.2 MEG
6C4
V2
RESET TIME
7.5 MEG R23
C9
C10
SPKR
BREAK
MOD & AF OUTPUT TRANS
FROM SEND-RCV RELAY
MIKE JACK
TO AF INPUT GRID
OFF
ON
BUZZER, BELL OR AUTO HORN
VOLTAGE SOURCE
CB TRANSCEIVER
POWER TRANS
D1
D2
2.7K
117 VAC
S2 ON-OFF

Diagram of the GD-162. An unusual 4-channel reed relay is the heart of the unit.

An unusual four-channel resonant-reed relay is used as the tone-selective device when monitoring and as the heart of the tone generator when calling another station in the net. The SELECTOR control on the front panel is a part of the relay. It is set to operate on only one of the four available tones, or on any one of the four when set to the MON ALL position.

The GD-162A Tone Squelch is a base unit that operates from 117-volt ac lines. The GD-162D operates from 6- and 12-volt vehicular batteries.

The figure shows the GD-162A as it would be connected to the audio and control circuits of a typical 5-watt transceiver. The GD-162 is mounted close to the transceiver. The microphone is normally left in the microphone hanger on the Tone Squelch panel. A switch on the hanger opens the ground side of the speaker circuit when the mike is hung up.

When the correct tone is transmitted by another station equipped with Tone Squelch, the signal is tapped off the transceiver's audio circuit—generally the high side of the volume control—and amplified by V1 and fed to the coil of resonant-reed relay RY2. When driven at its resonant frequency, the selected reed (terminal 3) vibrates and touches one of the fixed contacts (connected to the arm of S1-c). The reed is connected to B-plus through R3. As the reed vibrates, it produces positive pulses that are stored in C9 until the charge is high enough to overcome the fixed cathode bias on V2. V2 then conducts and energizes relay RY1. This closes the speaker circuit so the tone and identifying call sign can be heard and removes the ground from one side of the CALL lamp so it lights. (The SELECTOR control, though not shown on the schematic, is a part of RY2. It consists of a series of cams that damp all reeds except the one selected. All reeds are free to vibrate in the MON ALL setting. Only one reed is shown of the four connected to terminal 3. The reader may think of the diagram as an end-on view.)

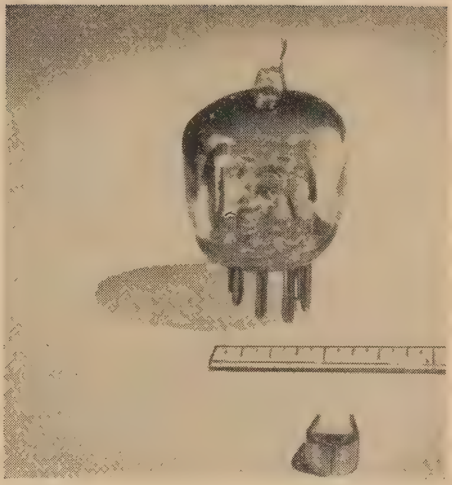
A time-delay circuit keeps the relay energized for up to 10 seconds after the tone ends. This holds the squelch open long enough for the calling station to identify itself. When RY1 is unenergized, C10 is connected across a part of a B-plus voltage divider consisting of R18 and R23. The setting of R23 determines the amount of charge on C10. When RY1 operates, C10 and R23 are connected to V2's grid through R19. V2 continues until C10 discharges below the level required to keep the relay energized.

To originate a call, remove the mike from the hanger and listen to make sure that the CB channel is clear. Set the SELECTOR to the desired tone channel and press the CALL switch (S1) for 3 to 5 seconds.

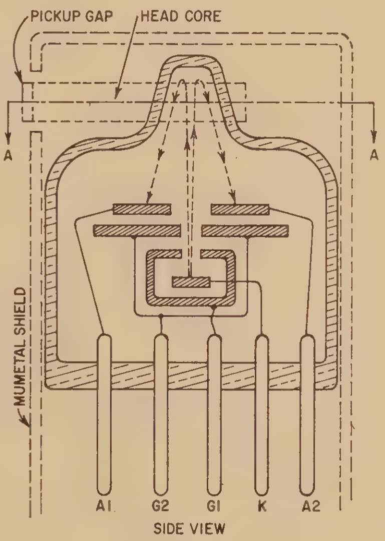
When the switch is pressed, the selected reed and the grounded pole piece of RY2 form a "variable capacitor" in a positive feedback loop around the amplifier (V1-a and V1-b). Transients or random circuit noise cause the selected reed to vibrate at its resonant frequency. The reed is polarized with dc through R3. As it vibrates at an audio rate, its constantly changing capacitance develops a corresponding audio voltage across R3. This voltage reinforces the original transient or pulse at V1-a's grid, sustaining oscillation at the reed's frequency. V1-b's output is tapped off and used to modulate the transceiver's transmitter.

An agc network consisting of D3, C7, R12 and R4 provides a bias that limits the tone amplitude to between 1 and 1.5 volts rms. The OUTPUT LEVEL control is set so the tone modulates the transmitter between 90 and 100%. END

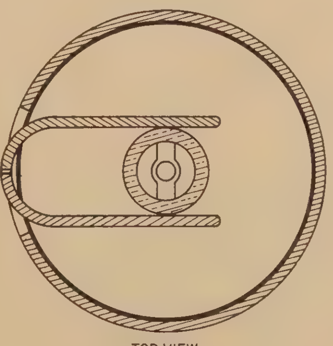
Electron Cloud Head for Tape Playback



AN INTERESTING AND POSSIBLY REVOLUTIONARY new playback head was described by Marvin Camras at the 1962 Audio Engineering Society Convention. The new head is, in effect, a small vacuum tube, in which the electrons are deflected to one anode or another, depending on the polarity of the signal on the tape.



SIDE VIEW
a



TOP VIEW
(SECTION AA)
b
Fig. 1

The principle is shown in Fig. 1, side and top views of the new head. The envelope is a standard miniature tube. The electron beam is focused through G1, accelerated by G2 and passes between the two portions of the split anode A1 and A2. As the electron beam reaches the narrow portion at the end of the tube, the electrons slow down and finally reverse, being attracted toward A1 and A2, where they are picked up. The playback head is actually a U-shaped piece, with the ends close to the tip of the tube (Fig. 1-b). The gap is at the rounded portion of the U.

The pole pieces direct the magnetic field from the tape, so that it acts on the reversing electrons. More electrons are attracted to anode A1, reducing the number going to A2, when the instantaneous polarity of the tape is in one direction, and of course the process reverses when the tape is polarized in the opposite direction. Because the pickup is extremely sensitive to external magnetic fields, the whole unit has to be enclosed in a mu-metal shield.

The head is capable of producing an output up to 1 volt. Input impedance is extremely high, and the frequency response is expected to run from 0 to 10 mc. The new head avoids all the problems of coil resonance, etc., of the old magnetic head. On the other hand, its life is dependent on that of the heater, as with any other vacuum tube.

The new head is in the early experimental stages. Further work may turn up further advantages, such as the possibility of using an electron multiplier to increase sensitivity without tube noise. END

HOW to handle UHF

Technician's guide to uhf and its problems

By LON CANTOR*

THE ALL-CHANNEL TV BILL REQUIRING TV set manufacturers to build uhf tuners into all receivers shipped after April 1964 is law. New stations will be opening up all over the country. And industry leaders predict the next decade will see TV go to uhf. So it's a good bet customers in your area will soon be eager to receive one or more uhf channels.

What does the installing technician need to know about uhf? Experience with New York City's Channel 31 (formerly WUHF, now WNYC-TV) as well as older uhf channels throughout the country indicates that these points are most important:

Uhf cannot be transmitted as far as vhf at the same power. Since the lowest uhf channel is more than twice as high in frequency as the highest vhf channel, uhf is more closely restricted to line-of-sight distances. A ground-based uhf channel reaches only about one-third the distance of an equivalent vhf channel.

However, the FCC allows a uhf station to use three times as much power as a vhf station—1,000,000 watts compared with 300 kw. This supposedly equalizes the distance covered. Within approximately 40 miles of New York City, this seems to hold true. Beyond that distance, uhf signals appear to fall off more rapidly than vhf. A vhf channel can cause interference 100 miles past the point where useful signals are received, whereas uhf causes little or no interference more than 10 miles beyond its usable range.

Uhf is more easily absorbed than vhf. Building losses are higher, and even trees can cause severe signal loss. Many installations have worked well in the winter when the trees are bare, but pictures were snowy in the summer, especially when leaves were wet. Surprisingly, in New York City uhf reception was often superior to vhf in large steel and concrete buildings. Some believe that—in addition to the increased power of uhf—its improved penetration is partly due to the fact that a window is less than a wavelength wide at vhf but about two wavelengths wide at uhf.

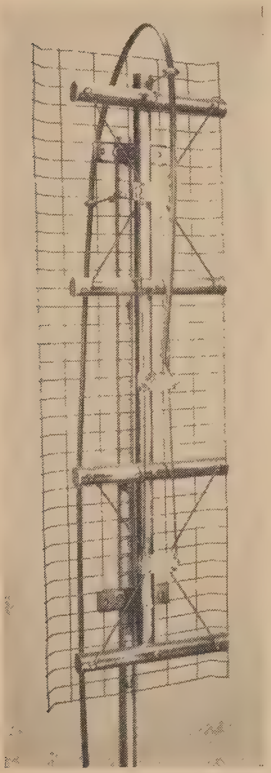
Uhf signals are attenuated more by cables. A hundred feet of dry 300-ohm ribbon line will attenuate channel 13 by about 1.8 db; channel 14 by 3.0 db, and channel 83 by 4.3 db. This attenuation can increase by as much as six times when the lead is wet or dirty.

How do these differences affect the TV technician? You'll have to find out for yourself just how far from the transmitter uhf signals can be received in your area, where indoor antennas can be used and when you will need elaborate outdoor antennas and signal boosters. Perhaps the experience of TV Miltie can help you.

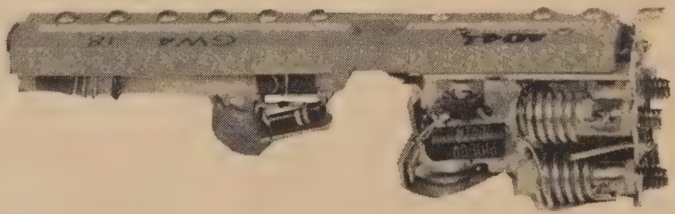
TV Miltie is probably New York City's most experienced uhf installer. He has a contract with Comeback Inc., an organization attempting to use channel 31 therapeutically for hospital patients. Miltie has equipped approximately 200 hospitals and institutions for uhf, as well as numbers of private houses.

Working within a 25-mile radius of the Empire State Building, Miltie uses indoor antennas with top-of-the-set converters. In all but two cases, he has been able to get good results. One was an apartment house blocked off from the Empire State Building by seven other buildings; the other a private house in the Bronx. He could do nothing in the apartment building. At the private house, he noted that the customer was using an outdoor conical vhf antenna and still getting poor results—even on vhf. He installed a four-bay uhf antenna and a uhf preamplifier. Result: sharp, snow-free pictures.

A few good uhf indoor antennas are on the market—the Finney model GMB and the JFD model TA149, to mention only two—but when Miltie started, none were available. Therefore, he designed two simple ones, a 300-ohm dipole and a bowtie with two quarter-wave conical sections on a rabbit-ear base. These proved quite effective, especially the 300-ohm dipole, which could be used indoors to probe for signals.


Antenna Designs

4-bay uhf antenna.


Typical uhf channel strip for tuner

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* Blonder-Tongue Labs., Newark, N. J.

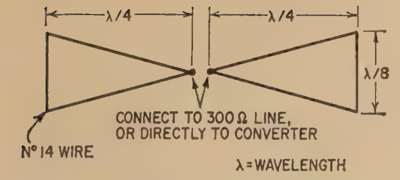


Fig. 1—Uhf antenna made from No. 14 wire.

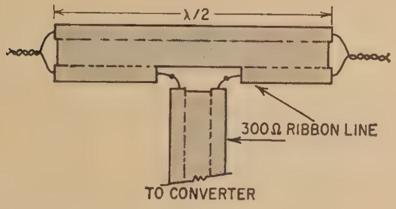


Fig. 2—Uhf antenna made from 300-ohm ribbon line.

It's simple enough to make your own indoor uhf antenna, either a bowtie type composed of a pair of conical quarter-wave sections (Fig. 1) or a 300-ohm folded dipole (Fig. 2). To compute the wavelength, use the formula:

$$\lambda = \frac{V}{F(.0254)}$$

where λ = wavelengths in inches, V = speed of light in meters (3×10^8), F = the uhf channel center frequency.

Using 575 mc, the center frequency of channel 31, we find that the wavelength of 31 is:

$$\lambda = \frac{V}{F(.0254)} = \frac{3 \times 10^8}{(575 \times 10^6)\,(.0254)}$$

$$\text{or } \lambda_{in} = \frac{11{,}800}{F_{mc}} = \frac{11{,}800}{575} = 20.5 \text{ inches}$$

The quarter-wave sections, therefore, are a little over 5 inches long. In computing the length of the half-wavelength 300-ohm folded dipole, we must also consider that the velocity of propagation in ribbon line is only 0.8 times that in air. The length of the line then is ½(20.5 × 0.8) or 8.2 inches.

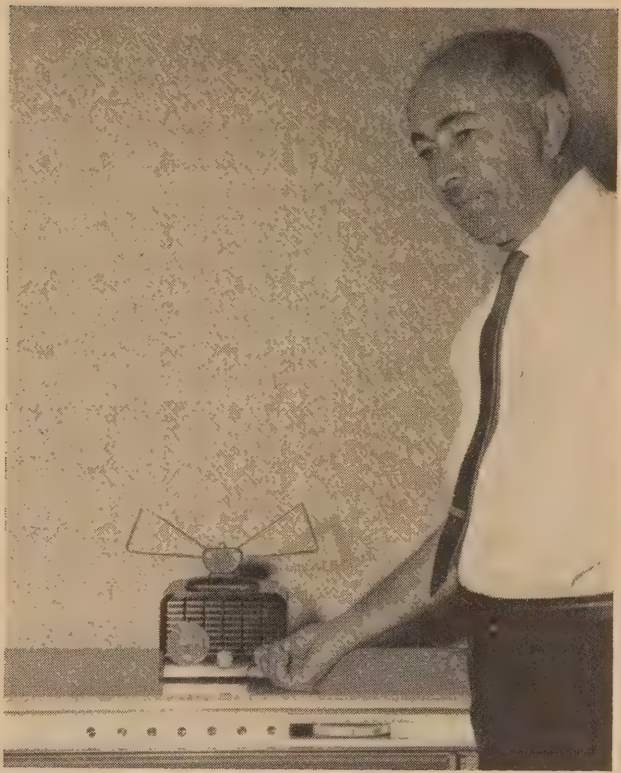
Choosing the antenna

Within about 20 miles of a uhf transmitter, an indoor antenna will usually be good enough. Of course, this depends on topography, buildings, etc. For distances of 20 to 30 miles, use an outdoor bowtie with a corner reflector. Be sure the mast is high enough to clear obstacles in the line of sight wherever possible. For locations 30 to 40 miles out, a four-bay antenna will be more effective. Fringe areas 40 to 50 miles away will probably require an eight-bay antenna plus a uhf preamp.

Converting TV sets

Of the more than 55,000,000 TV receivers in use, only about 10% are equipped to receive uhf. The other 50,000,000 or so must be converted, either with a tuner strip or a top-of-the-set converter.

TV Miltie with his quarter-wave rabbit ear.



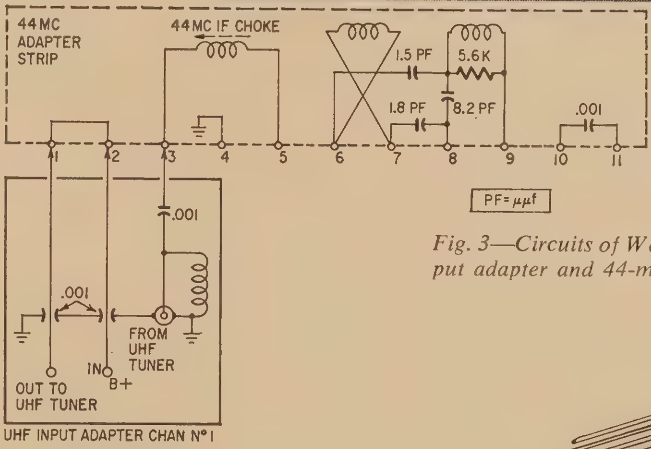
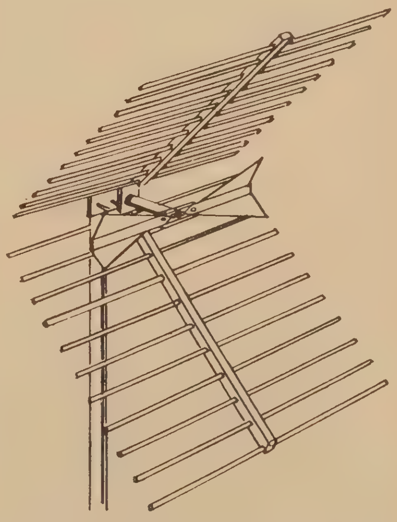


Fig. 3—Circuits of Westinghouse uhf input adapter and 44-mc tuner strip.

Most TV receiver manufacturers have now issued instructions on how to insert uhf strips. Westinghouse, for example, provides two methods, one for all-uhf channel reception using a uhf tuner and the other for reception of up to four uhf channels using channel strips.

To convert an existing 1962 Westinghouse receiver for a uhf tuner, a uhf input adapter and 44-mc adapter strip are required. They provide the extra connections and wiper contact which connect the uhf tuner into the circuit when the channel selector is switched to channel 1. Fig. 3 shows the circuits of these adapters. Terminals 1 and 2 supply B-plus to the uhf tuner. Terminal 3 receives the 44-mc signal from the uhf tuner, sending it through a 44-mc coil to the rf amplifier control grid on the vhf tuner. Contact 4 grounds the vhf antenna.



Uhf bowtie with corner reflector, similar to that made by several manufacturers.

The uhf tuner converts the channel to which it is tuned to 44 mc. This frequency is then amplified by the vhf tun-

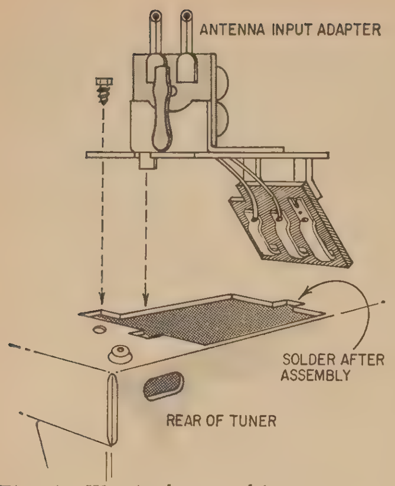


Fig. 4—Westinghouse uhf antenna input adapter.

er, which has been electrically altered by the 44-mc adapter. The vhf local oscillator is disabled by a capacitor which the adapter connects between its plate and control grid.

A strip-tuned Westinghouse vhf receiver can be adapted to receive one to four uhf channels using only an antenna adapter and uhf channel strips. The uhf antenna input adapter can be easily installed (Fig. 4). A uhf channel strip can be snapped into any unused vhf position. It is preferable, however, to use uhf strips only every third position, making four strips the maximum. Align the uhf strip just as you would a vhf strip, using the same access hole. Set the vhf fine tuner to the center of its range and use an alignment tool to adjust the uhf slug for best sound and picture.

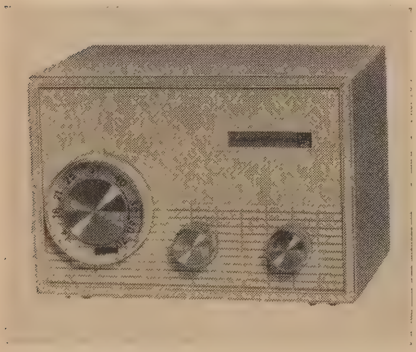
Other manufacturers make similar provisions. All Zenith sets can be converted with uhf channel strips. New Philco receivers use three basic tuners: one that accepts uhf strips, one that can be used with a separate uhf all-channel tuner, and one that can be adapted for uhf with either single-channel strips or an all-uhf tuner. Motorola offers a uhf strip kit similar to Westinghouse's, and Admiral provides either channel strips or a complete all-channel uhf tuner kit.

Converters

Perhaps the easiest way to prepare a set for uhf reception is with a top-of-the-set converter. These units are continuously tunable over the entire uhf spectrum. Use a nonamplified one-tube model for good reception areas. In poor reception areas, or if the TV receiver is old, use a two-tube model, which provides amplification as well as conversion.

The converter receives the uhf signal from the antenna and changes it to a vhf signal, either channel 5 or channel 6, whichever is unused in your area. It consists of two stages, an oscillator and a diode mixer. The incoming uhf signal beats with the converter oscillator frequency—the difference frequency being that of the vhf output channel. For example, the center frequency of channel 14 is 473 mc compared with 85 mc for channel 6. To convert 14 to 6, we simply tune the converter oscillator to 388 mc (473 − 388 = 85 mc).

One advantage of a top-of-the-set converter is that you won't have to take the back off the TV set. Therefore, it's apparent that conversion to uhf has not affected vhf reception. This can prevent disputes with set owners.



Top-of-set uhf converter with built-in amplifier stage.

A 300-ohm dipole is a cinch to put up.

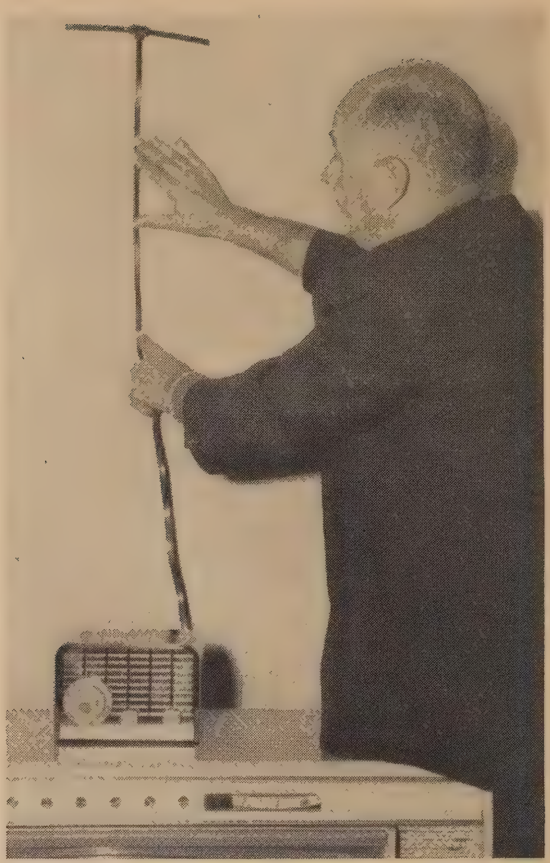
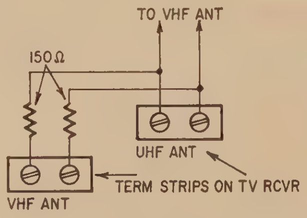


Fig. 5 (below) — Two 150-ohm resistors used an antenna splitting device.



Remember that the converter output is vhf. Connect it to the vhf antenna terminals on the TV receiver—not the uhf. In most sets without uhf tuners, the uhf antenna terminals are not connected to anything.

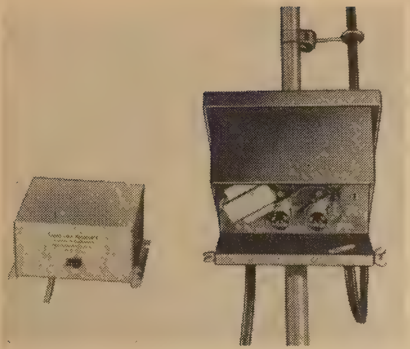
In the New York City area we have found that the channel 6 strip has been removed from a number of TV receivers. These strips must be replaced before the converter will work.

Installation procedure

1. Choose an antenna

Notice what type of vhf antenna is used. If it is a rabbit-ear, chances are you can use a uhf indoor antenna. In many cases, you can use the same rabbit-ear (but not the type with a single ear) for both uhf and vhf.

The built-in vhf antenna, consisting simply of a length of wire attached to the back cover, often does an excellent job for uhf. If the set has one, use it for uhf and a rabbit-ear for vhf. If neither the rabbit-ear nor the built-in antenna gives you good uhf pictures, try a separate indoor uhf antenna. An outdoor or attic vhf antenna will usually perform adequately at uhf. To be sure, try connecting it direct to the uhf terminal of the converter or TV set. If you get a good picture, split the signal with either a vhf/uhf splitter, such as the Blonder-Tongue model A107, or a pair of 150-ohm resistors (Fig. 5). Where the existing vhf antenna won't work, use a uhf



Blonder-Tongue model UB uhf preamp mounts on antenna mast.

outdoor antenna—with a preamp in fringe areas.

2. Probe for a signal

Uhf is funny. You can get nothing but snow in one part of a room, yet receive a clear, sharp picture at another place in the same room. For this reason, probing for a signal is important. Just move the indoor antenna all around the room till you find the best spot for it. This is especially easy with a 300-ohm dipole. It may not always be practical to leave the antenna in the best spot for reception, but find a good compromise.

Outdoors it's not as easy to probe for a signal. Just put the antenna as high as you can, orient it toward the transmitter and hope for the best. In New York City, we have found that reflected signals are sometimes stronger than the direct signals, so we orient the antenna toward the reflected surface. Once the installation is complete, you can reorient the antenna with the aid of a helper below, watching the TV set.

3. Run the lead-in cable

Remember that the higher the frequency, the greater the lead-in loss. Ribbon line attenuates uhf much more than vhf. So keep the lead-in as short as possible and don't use spliced pieces. Also watch your standoff insulators. Use as few as possible. Try to get the type that does not encircle the lead-in with metal. And if you do use the metal type, be sure not to squeeze it shut—a closed standoff acts just like a shorted transformer secondary.

Don't use either flat or hollow tubular 300-ohm line outdoors. Their attenuation factor increases as much as six times when they're wet or dirty. Use one of the new heavy-duty polyfoam cables, such as Belden No. 8325, Amphenol No. 214-05 or RCA No. 933014.

Keep lead-in at least 2 inches from all wires and metal surfaces.

4. Connect the lead-in to the TV receiver or converter.

5. Tune in a picture and reorient the antenna if necessary.

Following these simple procedures, TV technicians will find uhf little harder to handle than vhf. END

Improving Single-Ended Outputs

By JOHN A. MOONEY

THERE ARE MANY SCHEMES FOR IMPROVING the audio fidelity of small radios, phonographs and TV sets. All of these are designed to keep cost low.

My method is to connect the single-ended output stage in a screen-tapped configuration. Listening tests *with no plate-bypass capacitors and without feedback* show low distortion (especially at the high end) almost as if a triode were being used.

With most output tubes and 50% screen tapping (using a push-pull universal output transformer and connecting the screen to the center tap), output is about 1 or 2 db less than when using pentode connection. From the load point of view, the screen-tapped stage is better than the straight pentode (or beam power stage) especially without a separate feedback loop! I found the damping factor to be about 1, which seemed to be enough to prevent excessive low- and high-frequency response peaks with most speakers.

The main disadvantage of this connection is that poor B-plus filtering cannot be tolerated as well as in a pentode or beam power stage. For conversions where the screen was originally better filtered than the plate, it will probably be necessary to add a filter choke, since the plate and screen see the same point on the B-plus line! In the ac–dc receiver (Fig. 1), the original output transformer's primary winding will usually make an adequate choke coil. In TV sets and some console radios (Fig. 2), it is usually unnecessary to add additional B-plus filtering. Phonograph amplifiers may also be modified (Fig. 3).

On a conversion of this type, I do these basic things:

1. Remove all plate bypass capacitors.
2. Increase the value of all audio coupling capacitors.
3. Use a very large cathode bypass capacitor on the output stage to keep distortion low, especially at low frequencies.
4. Use approximately the same plate load and same bias as in the original pentode or beam power connection.
5. In radios, improve AM detector for lower distortion by separate-channel avc if practical.
6. In FM and TV sets, readjust high-frequency de-emphasis network if necessary for balanced response. (Some of the highs may have been deliberately attenuated by shunt capacitors in the original audio amplifier.) Increase the capacitance *across* the de-emphasis filter to get proper response.
7. Improve power supply filtering if necessary. Since the gain (power sensitivity) of the screen tapped output stage is only slightly less than the corresponding pentode or beam-power stage and since no feedback is used, no extra stages are needed! Driving voltage for the output stage will remain the same.

The 100,000-ohm plate load resistor reduces the maximum output voltage of the driver stage slightly, but drive is still enough to clip the output tube and before the clipping the driver, high-frequency response is better. END

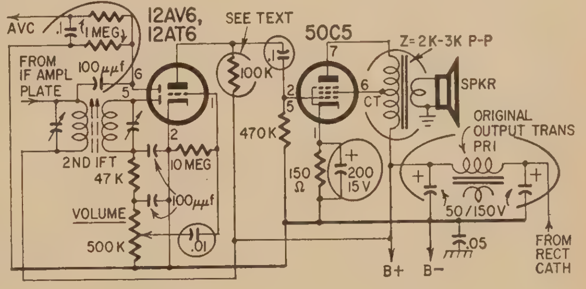

AVC
.1
1 MEG
12AV6,
12AT6
SEE TEXT
50C5
Z=2K-3K P-P
FROM
IF AMPL
PLATE
100μμf
6
5
100K
.1
7
2
5
6
CT
SPKR
1
2
470K
ORIGINAL
OUTPUT TRANS
PRI
2ND IFT
47K
10 MEG
1
150
Ω
+
200
15V
+
+
100μμf
50/150V
VOLUME
500K
.01
.05
B+
B−
FROM
RECT
CATH

Fig. 1 (top)—Audio stages of ac–dc radio. Circled parts have been added or changed.

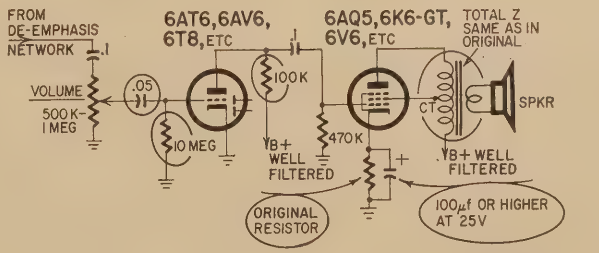

FROM
DE-EMPHASIS
NETWORK
.1
6AT6,6AV6,
6T8,ETC
.1
6AQ5,6K6-GT,
6V6,ETC
TOTAL Z
SAME AS IN
ORIGINAL
VOLUME
500K-
1 MEG
.05
100K
CT
SPKR
10 MEG
B+
WELL
FILTERED
470K
+
B+ WELL
FILTERED
ORIGINAL
RESISTOR
100μf OR HIGHER
AT 25V

Fig. 2 (above)—Audio stages of FM set or TV. Parts in circles have been added or their values changed.

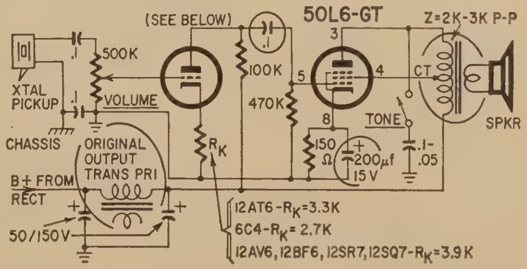

(SEE BELOW)
50L6-GT
Z=2K-3K P-P
.1
500K
.1
3
100K
5
4
CT
XTAL
PICKUP
.1
VOLUME
470K
8
TONE
SPKR
CHASSIS
ORIGINAL
OUTPUT
TRANS PRI
R_K
150
Ω
+
200μf
15V
.1-
.05
B+ FROM
RECT
+
+
50/150V
12AT6-R_K=3.3K
6C4-R_K= 2.7K
12AV6, 12BF6, 12SR7, 12SQ7-R_K=3.9K

Fig. 3 (right)—Improving a simple phono amplifier. Circled parts are new or have changed values.

multi-purpose 2-channel mixer preamp

4-transistor device adds flexibility to audio system

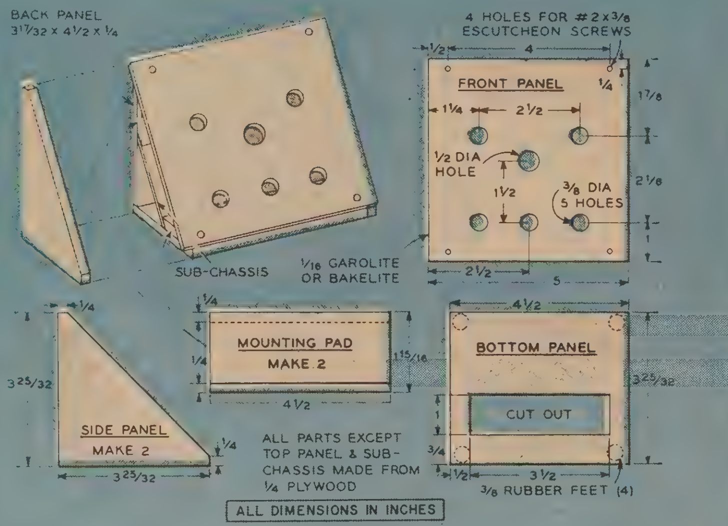

BACK PANEL
3 17/32 x 4 1/2 x 1/4
4 HOLES FOR #2 x 3/8 ESCUTCHEON SCREWS
1/2
4
FRONT PANEL
1/4
1 1/8
1 1/4
2 1/2
1/2 DIA HOLE
1/2
3/8 DIA 5 HOLES
2 1/8
2 1/2
5
SUB-CHASSIS
1/16 GAROLITE OR BAKELITE
1/4
3 25/32
SIDE PANEL
MAKE 2
3 25/32
MOUNTING PAD
MAKE 2
1 15/16
4 1/2
4 1/2
BOTTOM PANEL
CUT OUT
3 25/32
3/4
1
1/2
3 1/2
3/8 RUBBER FEET (4)
ALL PARTS EXCEPT TOP PANEL & SUB-CHASSIS MADE FROM 1/4 PLYWOOD
ALL DIMENSIONS IN INCHES

Fig. 1—Construction details for the mixer-preamp case. For greater protection against hum, the case could well be built from metal instead of plywood.

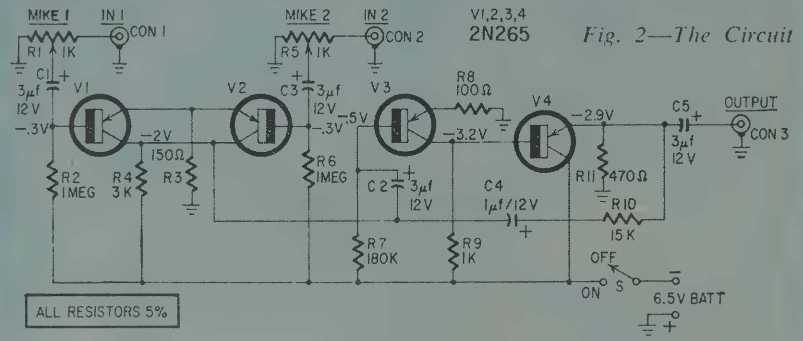

MIKE 1
IN 1
CON 1
R1
1K
C1
3μf
12V
-.3V
V1
-2V
150Ω
R2
1MEG
R4
3K
R3
MIKE 2
IN 2
CON 2
R5
1K
C3
3μf
12V
-.3V
V2
R6
1MEG
V1,2,3,4
2N265
V3
-5V
R8
100Ω
-3.2V
C2
3μf
12V
C4
1μf/12V
V4
-2.9V
R11
470Ω
R10
15K
C5
3μf
12V
OUTPUT
CON 3
R7
180K
R9
1K
OFF
ON
S
6.5V BATT
ALL RESISTORS 5%

Fig. 2—The Circuit

R1, R5 -pot, 1,000 ohms, audio taper
R2, R6 1 megohm
R3- 150 ohms
R4 3,000 ohms
R7 -180,000 ohms
R8 - 100 ohms
R9 -1,000 ohms
R10 15,000 ohms
R11 - 470 ohms
All fixed resistors 1/2-watt 5%
C1, C2, C3, C5—3 μf, 12 volts, subminiature electrolytics
C4 1 μf, 12 volts, subminiature electrolytics
BATT—6.5 volts, mercury (Mallory TR-135R or equivalent
CON 1, CON 2—microphone connector, chassis mounting, male (Amphenol type 75-CL-PC1M or equivalent)
S - spst toggle switch
V1, V2, V3, V4 - 2N265
Dial plates—0-100, 270°, 1 3/4-inch diameter
Case—see Fig. 1
Miscellaneous hardware

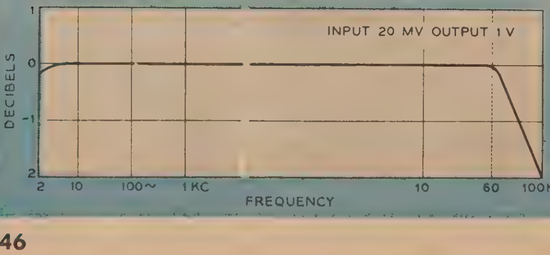


Fig. 3—Performance curve of the preamp.

By ALEX M. SCHOTZ

Add this dual microphone mixer–preamp to any audio amplifier, or make it part of the original design. Self-powered, it can be operated remotely from the main audio amplifier and features individual controls for each mike. This permits fine adjustment of either microphone, and electronic mixing of both. Because the preamp's final output stage is an emitter follower, it matches any power amplifier input impedance and also permits long leads between the preamp and main amplifier without loss of high frequencies.

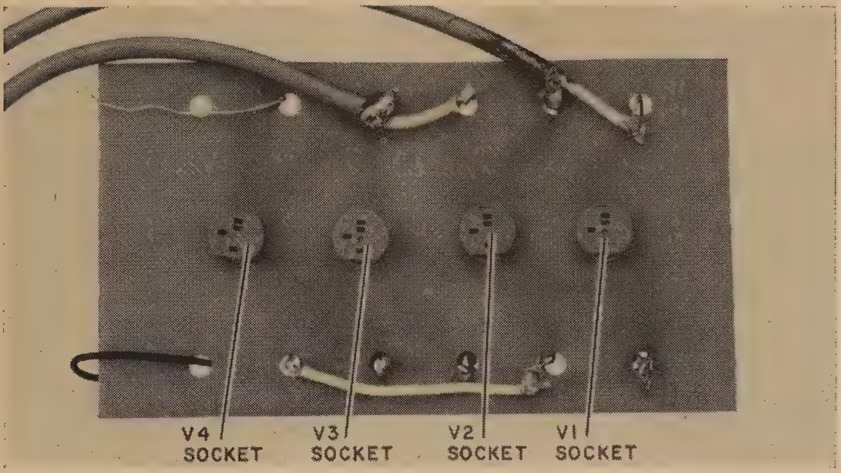
Parts layout and lead dress are not critical, although normal care and thought will make for greater efficiency. Fig. 1 shows construction details of the cabinet used. The circuit (Fig. 2) was designed to operate remotely from the main amplifier. The subchassis was assembled and wired separately, leaving leads long enough to reach both the input and output connectors, the batteries, controls and switch. The opening on the bottom board provides space to replace the battery without taking the unit apart. Low heat dissipation permits mounting almost anywhere.

The output impedance of microphones used with this preamplifier should be 600 ohms or less. If a high-impedance mike is used, you must add matching transformers to the inputs or the mikes. The advantage of a low-impedance input is that microphones can be operated with long lines between them and the preamp without any appreciable output voltage or frequency loss.

The frequency response at 1 volt output and 20 mv input is flat from 2 cycles to 60 kc and down 2 db at 100 kc (Fig. 3).

How it works

Microphone 1 feeds its signal across R1. This voltage is then fed through C1 to V1's base. V1 operates as a common-emitter stage whose out-



Top of the chassis board. Transistors have not yet been inserted into their sockets.

put appears across resistor R4, the common load resistor for V1 and V2. V2 is set up just like V1. It amplifies the signal voltage received from microphone 2. R2 and R6 provide the proper bias current. R3 helps stabilize both transistors and improves frequency response. The signal voltage from R4 is fed through C2 to V3's base. This is another common-emitter stage and further amplifies the signal. V3's output is direct-coupled to V4's base. V4 is a common-collector stage (the transistor counterpart of a vacuum-tube cathode follower) that maintains a low-impedance output without any loss of high frequencies.

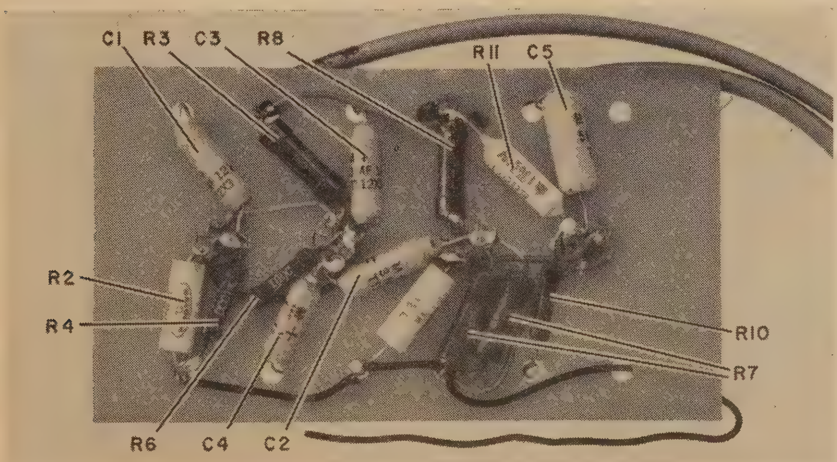
Feedback loop R10, C4, from V4's emitter, goes back to V1's and V2's collectors and provides 9 db feedback. Increasing the value of R10 reduces the feedback and increases amplifier gain, but affects the flat frequency response of the preamp.

With a 6.5-volt supply, maximum signal output before clipping is 1.7 volts rms. To extend the output signal voltage before clipping and to increase the overall amplification, increase the supply voltage (of course you cannot exceed the transistor ratings). If you increase the supply voltage, change bias resistor R7 so that half the battery voltage appears at V3's collector. The current drawn by the preamp will go up in direct proportion to the increase in battery voltage. Another method of increasing amplification (although frequency response, harmonic and intermodulation distortion will suffer) is to bypass R3 and R8 with large capacitors.

To minimize noise, use deposited-carbon resistors throughout. However, even with composition resistors, the measured noise of the output, with the input shorted, was −57 db.

This type of preamp has many practical applications. It can be used with a singer and orchestra, for individual speakers who are performing simultaneously, for mixing microphones with a tape recorder or record player, for sound effects, etc.

More input stages can be added with a small number of modifications to the preamplifier. Simply hook up similar transistors in parallel with V1 and V2, and change bias resistors R2 and R6 to provide the necessary bias. The bias resistor value should be the same for all input transistors. END



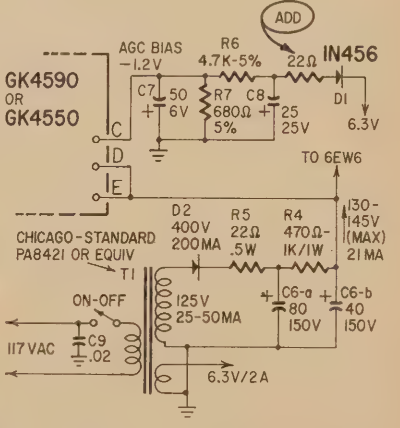
Parts layout under the chassis. Author used 1% resistors in several places, but the 5% values specified are all that are really needed.

more on the TV sound converter

A NUMBER OF READERS HAVE EXPRESSED interest in the converter for hi-fi TV sound in the December issue. The Standard-Kollsman GG-4290-A tuner specified in Fig. 1 is being replaced by the GK-4590 and GK-4550 covering 12 and 13 channels, respectively. These new tuners use a 6GK5 rf amplifier and a B-plus of 135-145 volts maximum.

When using a tuner with a 6GK5 rf amplifier, reduce the voltage at point E to 135-145 by adjusting the values of R4, R8 and R9 or by using the half-wave 145-volt power supply shown in the diagram. R8 and R9 are not needed when this supply is used. The values of R6 and R7 and C8 have been changed from those originally specified to provide optimum performance. With the lower voltage on the 6EW6 doubler, change the screen dropping resistor (R2) to 270,000 ohms.

If you use the GG series tuner as specified or a similar model with a 6ER5 rf amplifier and a 175-volt supply, change R4 to 4,500 ohms (5 watts), R6 to 4,700 and R7 to 820 ohms. Replace C8 with a 25-μf, 25-volt electrolytic (positive grounded) and insert a 22-ohm, 1-watt resistor between the 1N456 and the junction of R6 and C8. These changes stabilize the supply and bias voltages and increase the 6ER5 bias to minus 1.2 volts.



Circuit shows power-supply and agc-bias changes for newer G-K tuners.

Change R2 to 680,000 ohms for a slight increase in overall gain. END

Cathodic Protection— The Big Electronics

200,000 square feet of cathode and 32-pound anodes spell out electronics in capital letters

By CECIL BEELER

"Our cathodes average 50,000 square feet, calling for ten 32-pound anodes with a 30,000-ohm coating in our notorious 500-ohm soil. We take our potentials spring and fall. If the variation is over 0.15 volt or the average under −0.80 volt to a copper–copper-sulphate electrode, we check the section with a current requirement meter and sweep out trouble with an audio tracer. We're catching a lot of contacts and holidays but hardly any defective insulators or hot spots."

This wacky, yet strangely familiar jargon is the native tongue of *cathodic protection,* the Texas-size member of the electronics family, natural-gas utility branch.

Cathodic protection reverses the nature of things so that buried steel, such as a gas main, becomes cathodic to the electrolytic soil moisture it contacts. Anodes corrode, but a cathode repels the negative ions that do the damage.

Natural-gas pipeline companies are the greatest users of cathodic protection. They and their consultants have developed the instrumentation to provide perfect protection of buried steel, whether in a gas main or other structure.

Few technicians work more closely to their basic science or depend more on instruments. If some hard-bitten shopman is inclined to argue that the deal isn't electronic (granted, cathodic protection doesn't output toward a speaker coil), let him pick out his instruments and tramp his vast "chassis," of which nothing is to be seen but test boxes at every 1,000 feet or so.

Cathodic protection is properly added even to coated steel. Here it protects against defects in the coating. Even a puncture as small as a pinhole in the coating leads to corrosion that will eat a hole the diameter of a pencil through the 3/16-inch wall of a gas main in as little as 2 years. Cathodic protection keeps corrosion in check at any exposed patches of steel at a cost of ¼ of 1% of the cost of the gas main.

Cathodic protection is also added, a slightly higher cost, to bare and possibly badly corroded pipe to prevent further damage.

Enemy attack. This section of gas main was holed in three places by galvanic corrosion.

Corrosion principles

It's all deceptively simple. Who hasn't seen zinc and sulphuric acid combine into zinc sulphate? End of experiment—but it wasn't corrosion.

A galvanic cell—say a shorted "flashlight battery"—contains all the elements needed to illustrate the case: a metal, zinc, in contact with a dissimilar conductive material, in this case carbon, both immersed in a moist earth-like electrolyte. The electrons flowing from zinc to carbon through the short, in effect, ride horseback on ions through the electrolyte to the zinc. We know what becomes of a battery's zinc as it is swept over by metal-hungry negative ions.

Studying a corrosion tubercle (see "Enemy Attack" photo) you can almost see the hungry negative ions back out of the hole they are chewing to spit out a mouthful of iron, then go back for another bite. Actually, soil oxygen takes out the iron as oxide, freeing the ions to repeat the process and carry on the corrosion as long as a particle of metallic iron remains.

Right about here is where the big electronics takes over. Break up a galvanic cell and you break up its corrosion but, try as you might, not every last cell can be exterminated.

If you're thinking that, since the trouble is entirely caused by negative ions, why not shoot a negative bias potential into the metal to be protected and blast out the attackers, you're a genius. You have just re-invented cathodic protection!

It doesn't take much. The current required to protect coated pipe is up to 15 μa per square foot.

Iron is about the most difficult to protect. It is anodic to about three-quarters of the common metals. It also seems to delight in being anodic to itself, with endless chances for galvanic cells to be formed. Between ferrous iron (the most anodic form) and ferric iron lies a rising scale of seven gradually less anodic metals.

Welds may be anodic to the parent metal, malleable iron anodic to mild steel, and even new steel to older steel of the same composition.

However, magnesium and zinc are anodic to iron and are satisfactory in other ways. They are available as ingots weighing up to 32 pounds, prepared with a wire for attaching them to the iron. When installed, each anode, as it is commonly called, supplies more than 1 volt for cathodic protection and up to about 250 ma for 5 to 10 years for the largest size.

The job can also be done by feeding negative dc to the pipe, with a carbon or other corrosion-resistant buried anode to complete the circuit. This method is favored for the big cross-country pipelines. Tapped transform-

How to trace a shorted cathode, 5000 square feet or more of cathode, that is. Hook up an audio pulse generator to your cathodically protected gas main and a ground probe (left). Then, with the receiver unit, follow the beep-beeps as they take a path to ground through the short.

ers and rectifiers with a top of about 18 volts are usually used.

Test equipment

A short circuit is as disastrous to cathode protection as to any electronic rig. So is loss of power supply, imbalances and those faults that are supposedly impossible. Many a protection area is found to be as full of what-is-it and where-is-it as a junior science superhet.

And all this 3 feet under sod and paving. Small wonder that any cathodic protection instruments that come into your hands show distinct signs of wear.

A soil resistivity tester is often used throughout an area to determine how corrosive the soil is likely to be, before any steel is installed. One such instrument is hooked to a row of four small probes shoved in the ground. A careful reading, a simple multiplication, and the average soil resistivity is obtained to the depth of the spacing of the two inner probes. In soil that measures over 10,000 ohms per cubic centimeter, corrosion is expected to be light. If resistance is 1,000 ohms, corrosion will be serious.

After the pipe is laid, this instrument may be used to find belts of more corrosive soil that are making "hot spots," conducive to uneven protection.

A good dc voltmeter with a 0- to 2- or 3-volt scale is the workhorse of cathodic protection instruments. "Pipe-to-soil" from aboveground parts of the steel, or test wires from it in permanent check-point terminals, show whether the cathodic protection is effective. Contact with the soil is made through a standard soil electrode, available in the trade, which makes the needed electrolyte-to-electrolyte contact through a porous bottom plug.

Recommended sensitivity for this work is 50,000 ohms per volt or better. A 20,000-ohm vom can do the job, except for an occasional low figure due to loading the electrode's contact area. For a vtvm you would need a portable power supply. Best of all is a potentiometer-voltmeter which is rated up to 100,000 ohms per volt.

An audio tracer is the hardest-working instrument when cathodic protection trouble is to be cleared up.

It leads the receiver-bearing operator by the most direct electric route from the transmitter to the nearest and biggest short to ground. On the way it ticks out patches of bare steel on coated mains with a hint as to the area of each one. A U-core coil can be plugged into the receiver and used to examine an insulator that is less than 1 ohm to ground on both sides, and report whether it is good or not. The same coil can explore a network of pipes and point to the exact point at which the signal meets a short.

These instruments were designed only for tracing underground pipe or cables. Their use in spotting protection trouble was discovered at about the same time by several gas utilities.

They pour a ground-seeking audio pulse of no more than 1,000 cycles for a sine wave, or the hashy output of a buzzer circuit, into the pipe. This signal promptly flows to the holes that were making havoc for the cathodic protection and there dissipates.

Pipe locators that work on the beat frequency of two low rf oscillators when used this way are . . . well, they are good pipe locators.

Problems do come up

Now let's examine a typical everyday problem. A 10,000-foot length of 8-inch coated pipe has a potential of about 0.8 volt, a little low, which dips to 0.68 volt in one reading. The current taken is 300 ma, up 50 ma from the previous reading.

Since this size pipe is about 20 miles per ohm, the IR drop at 300 ma maximum would be too small to work out, except with a very sharp pencil. Could be a hot spot, a drift of extra corrosive soil, but a hot spot doesn't move in between readings. A short would drag much more current and much lower potentials than those found.

That left the suspicion of a large area of bare metal, such as could be caused by damage while excavating near the pipe. The escaping electrons set up a potential gradient as they flow through the soil, which, in this case, would amount to 0.12 volt subtracted from the applied 0.80 volt between the pipe and average soil.

The audio tracer was called in and readily spotted the bare surface at a point found to have been the scene of repair work. It could have been dug up and retaped, but it was easier to install an extra anode to cancel out the dangerous voltage gradient. END

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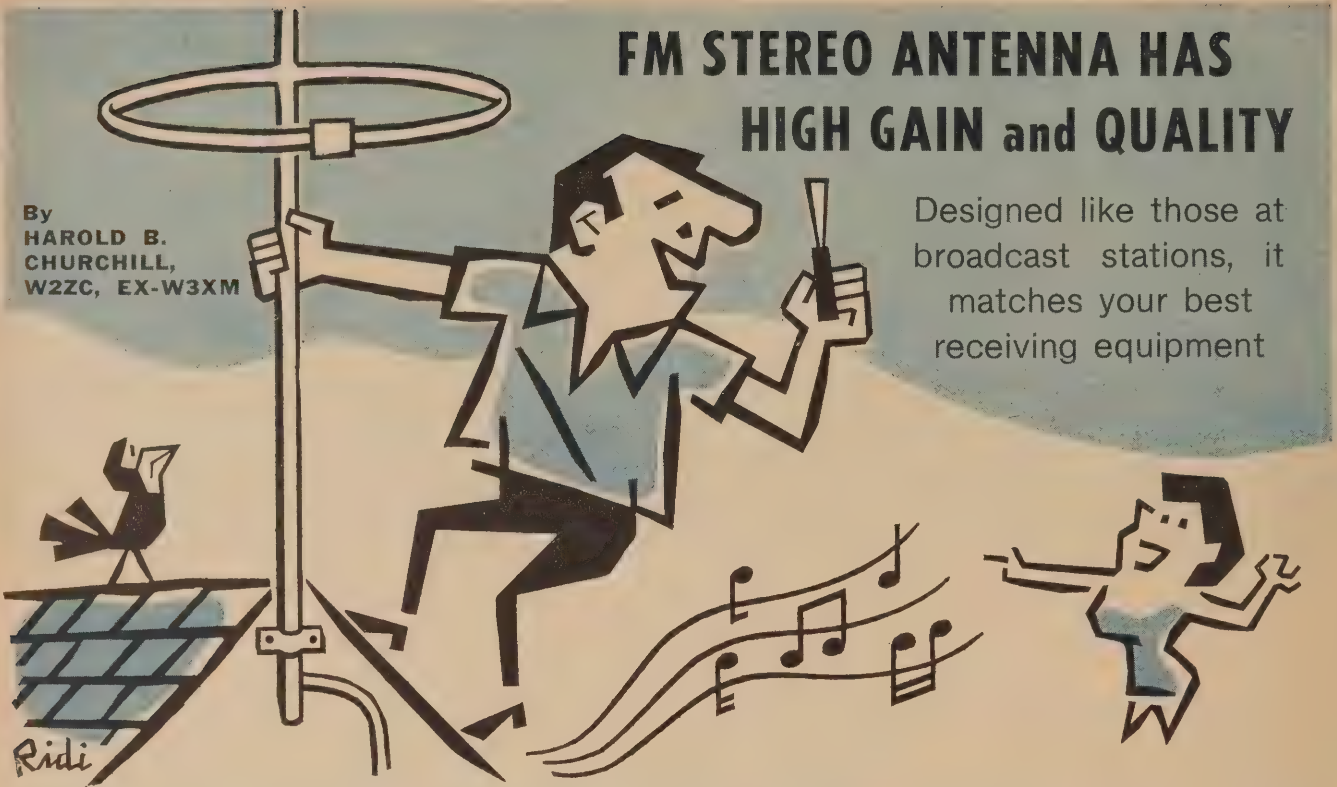
Proceedings of Annual Appalachian Underground Corrosion Short Course, (Papers of graduated and classified lectures). West Virginia University Bulletin, Morgantown, W. Virginia.

Using a special-purpose multimeter to check the cathodic protection voltage of a section of main.

FM STEREO ANTENNA HAS HIGH GAIN and QUALITY

By
HAROLD B. CHURCHILL,
W2ZC, EX-W3XM

Designed like those at broadcast stations, it matches your best receiving equipment



Not long ago, a senior music professor at one of our large universities bought one of the finest FM and stereo systems made. "Now what I need," he told me, "is an antenna in the same class. What should I get?"

"Order an antenna just like the ones FM broadcasters use for transmission," I replied. The professor was enthusiastic, but taken aback by the cost. "But," he countered, "couldn't a man build one himself, using somewhat the same design, but for a lot less?"

"Of course," I told him, "and perhaps it could weigh a tenth as much." So the antenna described on these pages got under way. Fortunately, excellent measuring and analysis equipment was available, so computation was checked as each element was added, and the overall array analyzed as an entity. From the start, the prototype antenna turned out such unusual performance that it has since been copied by other musically minded members of the faculty who are now enjoying mono and stereo FM stations they didn't realize were on the air.

The concept of this very light array is derived from the typical FM broadcaster's antenna. Look at one carefully and you'll find, more often than not, it uses a needlepoint mast encircled by three or more metallic halos, arranged one over the other. In operation, each acts as a circular, folded dipole having a 180° phase differential between halos. This circular halo form produces an omnidirectional signal pattern. Acting together, the halos deliver maximum signal toward the horizon at virtually 0° of vertical angle.

The array described is in many ways the receiving counterpart of the FM broadcaster's antenna, and in operation the similar merits of both combine and add together for the strongest transfer of signal between the two. The builder, however, can choose between omnidirectional reception and bi-directional gain. He can use one or the other, depending on the compass bearing of stations he wants to receive.

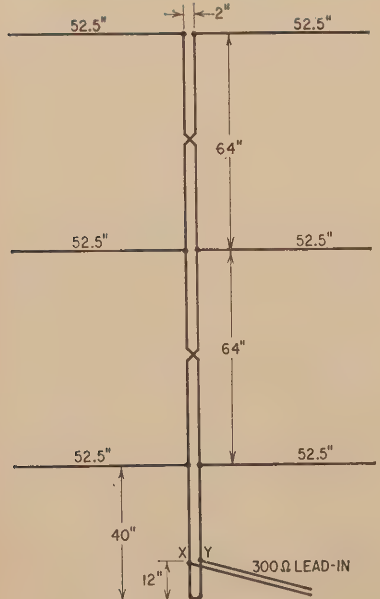


Fig. 1—Antenna dimensions and lead-in connection.

Design problems

Besides high gain, this antenna had to stand up under heavy icing, snow and wind. So a construction decision had to be made: whether to employ heavy duraluminum as the FM broadcasters do and counter bad weather by massive strength, or deal with it as a willow tree does, by sheer whip and flexibility. The second choice was made, at a tenth the cost, and with expected results. During the heavy icing conditions of Christmas 1961, local casualties among aluminum-tube TV antennas ran high. But the willow-whip arrays in use simply drooped under ice, and snapped back into position when it melted. No replacements needed.

Fig. 1 shows the antenna design and dimensions in drafting form. Oriented as shown, six spines project from the mast and work as six half-waves in phase, appropriately phased. In antenna shorthand, they function as "two over two over two." Oriented as shown, the spines are bi-directional broadside with a beam width of 120° in both directions.

If the user lives between two cities, the array can be oriented broadside to each, giving a wide variety of stations

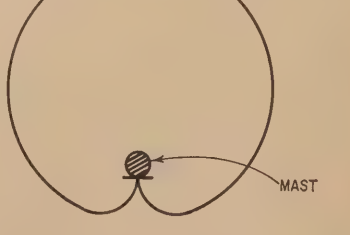


Fig. 2—For omnidirectional reception, spine pairs encircle mast. Lucite insulating strip completes loop, but insulates end of one spine from another.

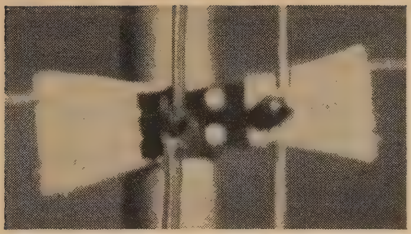


Fig. 3—Clamp insulators from Telrex "Bow Tie" antenna attached to mast. Antenna spines project to left and right. Vertical transmission line is bolted to metallic strips at each side of insulator.

and programs to choose from without rotation. If circular and nearly equal reception from all directions is desired, the spines can be bent to encircle the mast in the form of halos, just as in FM broadcast transmission. This is shown in Fig. 2, looking directly down on top of the mast.

Construction begins

The physical makeup features extreme lightness and flexibility in the dipole spines. They present no problem in a high wind, offering little resistance, and simply flex with it. The supporting mast for the array is rapidly assembled from two lengths of standard aluminum TV tubing, one with slightly greater diameter than the other, allowing the smaller (the topmast) to be inserted in the larger. A sharp tap of a hammer insures a permanently tight fit. In the prototype model, this gave us a mast 21 feet high. The six antenna spines must be insulated from the metal mast. This is readily done by either of two methods. The first is by cutting rectangular pieces of Lucite, 2 x 5 inches. These are secured to the mast by aluminum through-bolts, and the spines secured to the Lucite by small clamps. The simpler way (Fig. 3) is to replace the Lucite rectangles by clamp insulators used in Telrex's very inexpensive Bow Tie TV antenna. These serve the purpose ideally, and come equipped with the needed hardware.

The No. 8 steel wire used for the antenna spines is available at most any heavy-hardware or farm supply store. In the prototype antenna, the wire was appropriated from Telrex Bow Tie loops. This wire is strong and whippy and, once shaped by flat pliers, maintains shape. Skin-effect loss through using steel instead of aluminum was unmeasurable at the limiter of a Harman-Kardon receiver.

As seen in Fig. 1, the open-wire transmission lines connect the upper, middle and lower pairs of antenna spines. These lines are cut from standard aluminum TV ground wire, available at most TV and some hardware stores. The two wires are separated 2 inches, and held in place by standard 3½-inch TV lead-in standoffs fitted with pole straps. These are positioned halfway between the antenna tiers where loss is very low, since the signal voltage is lowest here. Construction is straightforward, as shown in Fig. 4. These lines must be transposed once between the upper and middle tiers of antennas, and again between the middle and lower (Fig. 1). If these transpositions are overlooked, the array becomes susceptible to reflections from planes directly overhead, and behaves as a conventional antenna in this respect.

Lead-in

As seen in Fig. 1, the transposed transmission lines terminate at their bottom in a hairpin stub 40 inches long. This is cut from the roll of wire used for the lines, and shaped by hand. This closed hairpin stub acts as an impedance transformer. A standard 300-ohm TV line connects at points X and Y, 12 inches from the closed bottom of the stub.

If the array is completely clear of nearby objects, an alternate feed method works very well. Cut the bottom of the hairpin stub open, and attach the 300-ohm Twin-Lead (by electrician's lugs) to its now open ends. The stub then acts as a geometric mean impedance between the bottom of the array and the 300-ohm ribbon line.

For summer use, especially in heavy thunderstorm areas, grounding the array provides excellent lightning insurance. But, contrary to popular opinion, this safety does not lie in having a massive circuit to ground for lightning to follow (a ground wire is often vaporized by a 400-ampere charge). It comes about through another action: an antenna that is high and grounded helps clear the air of electric potential that could lead to the antenna or its supporting building being struck. So a good ground acts in effect as an atmospheric bleeder, providing an umbrella of comparative protection. A survey of lightning strikes at one beach resort last summer proved a grounded TV antenna was very rarely hit.

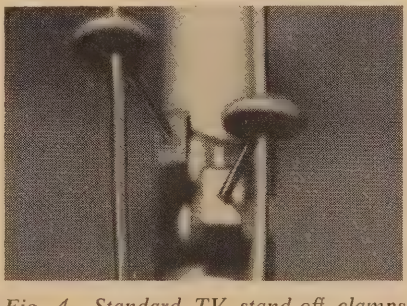


Fig. 4—Standard TV stand-off clamps can also be used to support the transmission line. They are placed midway between antenna tiers to keep signal loss negligible.

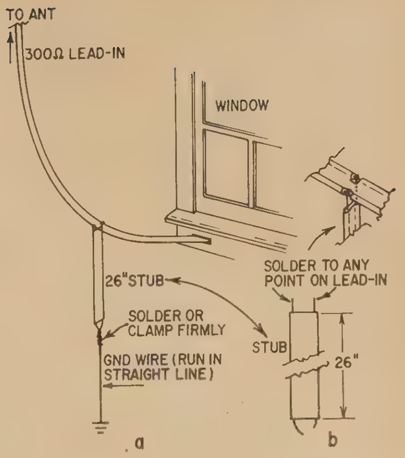
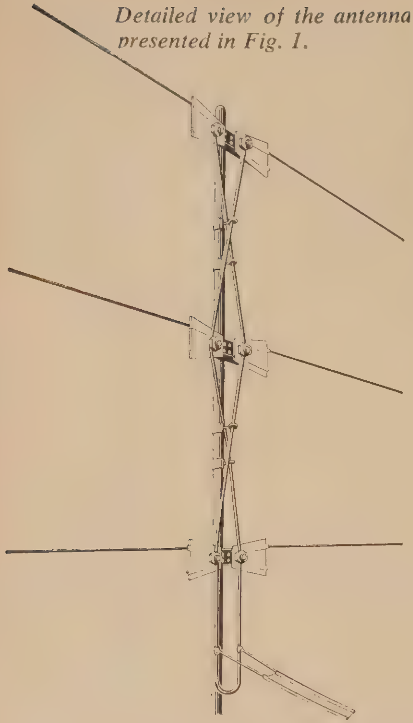


Fig. 5—In (a) typical connection of grounding stub to lead-in is shown; (b) is a close up of the stub. In the FM band, the stub acts as a parallel-tuned L-C circuit with very high impedance to rf. To a static charge, it looks like a solid metallic path to ground.

The best method of grounding this array (and indeed all TV antennas) is to ground the supporting metal pole. If this is impractical, an excellent permanent ground for FM reception may be made for a few cents by shorting one end of a 26-inch length of 300-ohm line, and grounding the shorting point. Solder the open ends of this little stub to any point on the 300-ohm lead-in proper (Fig. 5). The stub acts as a metallic insulator, passing atmospheric charges to ground, but having no effect whatever on FM reception. The best point for attachment is just before the lead-in enters the building, and a straight-line wire run directly to ground from the stub's shorting point. (The 2-foot 2-inch stub length *will not work for TV reception.* Other lengths are needed, depending on the channels to be received.)

Results

When this array is correctly installed, two indications of performance appear immediately. Stations formerly offering only fringe and marginal reception for the most part assume the solidity of locals. This stems from more adequate limiter voltage, a necessary cushion for adequate reception. Stations which were not heard before make their appearance on the dial. The very high gain of this broadcast type antenna is effective virtually across the FM band, since the six fin dipoles are effectively in parallel, leading to a reduction in Q, and therefore increased frequency sensitivity. Despite this very high gain, interference between stations is rare, thanks to today's noninterfering FM frequency allocations. Rather, the FM band on a good tuner typically becomes twice as populated, doubling program selection (except for stations fed by the same network).



Detailed view of the antenna presented in Fig. 1.

Those interested in quantitive tests (as I am) will find their tuner limiter saturated by very large signal voltages. If measurements are compared on a side-by-side basis with another antenna, the readings delivered by this array are a direct measure of improvement.

This very high gain will cause other effects. By concentrating reception on the horizon, fading from overhead plane reflection is reduced 6 db or more over a conventional FM antenna. For the most part, fading is apparent to the eye as limiter reading, not to the ear, due to the heavy cushion of signal voltage. Where long-distance troposphere signals formerly caused interference, the larger limiter voltage now "captures" the receiver for the primary area signal. But this isn't to say troposphere reception disappears. When the troposphere path is open, this broadcast-station type array will deliver signals with far greater strength. But when the troposphere path closes, the signal disappears since no amount of gain will be responsive to it.

Extensive testing of the prototype of this array showed that it surpasses by a considerable margin the more expensive Yagi antennas designed for vhf television reception. This was expected, since the TV Yagi is at the great disadvantage of requiring peaking between channels 2 and 5, and again between 7 and 13. Likewise, the conventional X-type TV antenna is at a disadvantage. Functioning as a half-wave dipole on the lower channels, it behaves much as a 110° V on the higher channels. On FM, it is neither fish nor fowl. If reception is strong, it is due largely to the massive power of the transmitter. END

TV Frequency & Marker Chart

BY DON DUDLEY

WHEN MAKING A QUICK CHECK FOR TV tuner alignment, a list of channel frequencies and their video and sound carriers will come in handy.

Each channel is 6 mc wide, and the video carrier in each is 1.25 mc above the low limit. There is the standard 4.5 mc between video and sound carriers. This places the sound carrier 0.25 mc below the high-frequency limit of the channel. The sweep picture as seen at the looker point (rf test point) is shown in Fig. 1.

Those who doubt the accuracy of their markers can use the transmitted sound and video carriers by using the hookup in Fig. 2. Use a resistance value that gives a clear undistorted marker.

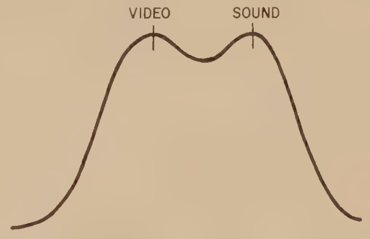


Fig. 1—The waveform at the TV tuner looker point.

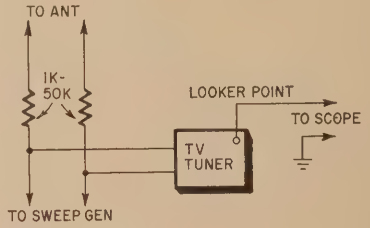


Fig. 2—With this arrangement you can use TV station signals as markers.

Channel No.	Frequency Band (Mc)	Video Carrier	Sound Carrier
2	54–60	55.25	59.75
3	60–66	61.25	65.75
4	66–72	67.25	71.75
5	76–82	77.25	81.75
6	82–88	83.25	87.75
7	174–180	175.25	179.75
8	180–186	181.25	185.75
9	186–192	187.25	191.75
10	192–198	193.25	197.75
11	198–204	199.25	203.75
12	204–210	205.25	209.75
13	210–216	211.25	215.75
14	470–476	471.25	475.75
15	476–482	477.25	481.75
16	482–488	483.25	487.75
17	488–494	4.89.25	493.75
18	494–500	495.25	499.75
19	500–506	501.25	505.75
20	508–512	507.25	511.75
21	512–518	513.25	517.75
22	518–524	519.25	523.75
23	524–530	525.25	529.75
24	530–536	531.25	535.75
25	536–542	537.25	541.75
26	542–548	543.25	547.75
27	548–554	549.25	553.75
28	554–560	555.25	559.75
29	560–566	561.25	565.75
30	566–572	567.25	571.75
31	572–578	573.25	577.75
32	578–584	579.25	583.75
33	584–590	585.25	598.75
34	590–596	591.25	595.75
35	596–602	597.25	601.75
36	602–608	603.25	607.75
37	608–614	609.25	613.75
38	614–620	615.25	619.75
39.	620–626	621.25	625.75
40	626–632	627.25	631.75
41	632–638	633.25	637.75
42	638–644	639.25	643.75
43	644–650	645.25	649.75
44	650–656	651.25	655.75
45	656–662	657.25	661.75
46	622–668	663.25	667.75
47	668–674	669.25	673.75
48	674–680	675.25	679.75
49	680–686	681.25	685.75
50	686–692	687.25	691.75
51	692–698	693.25	697.75
52	698–704	699.25	703.75
53	704–710	705.25	709.75
54	710–716	711.25	715.75
55	716–722	717.25	721.75
56	722–728	723.25	727.75
57	728–734	729.25	733.75
58	734–740	735.25	739.75
59	740–746	741.25	745.75
60	746–752	747.25	751.75
61	752–758	753.25	757.75
62	758–764	759.25	763.75
63	764–770	765.25	769.75
64	770–776	771.25	775.75
65	776–782	777.25	781.75
66	782–788	783.25	787.75
67	788–794	789.25	793.75
68	794–800	795.25	799.75
69	800–806	801.25	805.75
70	806–812	807.25	811.75
71	812–818	813.25	817.75
72	818–824	819.25	823.75
73	824–830	825.25	829.75
74	830–836	831.25	835.75
75	836–842	837.25	841.75
76	842–848	843.25	847.75
77	848–854	849.25	853.75
78	854–860	855.25	859.75
79	860–866	861.25	865.75
80	866–872	867.25	871.75
81	872–878	873.25	877.75
82	878–884	879.25	883.75
83	884–890	885.25	889.75

They tell you things about your equipment you can't find out with a multimeter

The Waveforms Tell the Story

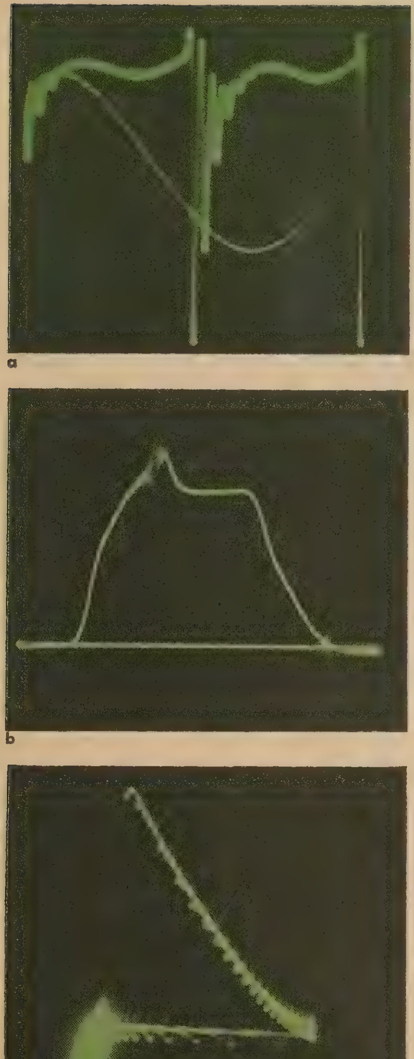


Fig. 1—Three basic types of waveforms; a — complex wave; b — frequency response curve; c—cyclogram.

By ROBERT G. MIDDLETON

THERE ARE THREE PROTOTYPE WAVEFORMS in ordinary electronic circuits. They are the complex wave, the frequency response curve and the cyclogram (Fig. 1). All are built up from sine waves. Although this is not obvious, it is easily shown with simple filters.

For example, if we pass a 60-cycle square wave through a 60-cycle electronic filter, we get the output waveform shown in Fig. 2. What happened here? The filter removed the 60-cycle fundamental from the waveform. The output consists of the third harmonic, fifth harmonic, seventh harmonic, etc. All the component frequencies are in the output waveform except the fundamental 60-cycle frequency.

Note that the phase of the 60-cycle fundamental does not seem to be exactly the same as the phase of the 60-cycle square wave in Fig. 2. The reason for this is a phase shift in the electronic filter. No filter is 100% perfect, and the filters used in audio work generally have an appreciable phase shift.

A sawtooth is also built up from sine waves. If we pass a 60-cycle sawtooth through a 60-cycle electronic filter, we get the output waveform of Fig. 3. The 60-cycle fundamental has been removed from the sawtooth. We see that waveform analysis is not a theoretical subject, but a matter of practical circuit action.

Sine waves which build up complex waves have definite phases. They become apparent when we pass a complex wave through a filter. In Fig. 2, the envelope of the waveform outlines the sine wave which has been removed. In turn, the 60-cycle fundamental in the square wave is 180° out of phase with the outline of the envelope.

A power supply filter differs from a wave filter in an audio harmonic-distortion meter. It is not tuned. A "brute-force" filter, it is designed to remove all frequencies from a complex waveform. When this is done, only the dc component is left.

Of course, brute-force filters are not 100% perfect. Some ac voltage gets through. In addition to the 60-cycle ripple voltage, we find residues from the deflection circuits in the TV receiver. This happens because the filter capacitors are sometimes decoupling capacitors for the various receiver sections.

Thus, we find prominent frequency components in the filter output waveforms at 60 and 15,750 cycles. Suppose one of the filter capacitors loses an appreciable amount of its capacitance. A scope connected between the dc side of the rectifier and ground displays

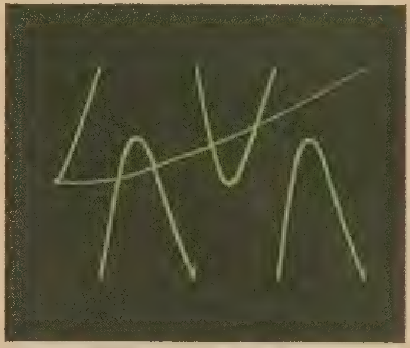


Fig. 2—All that's left of a square wave after the 60-cycle fundamental is removed.

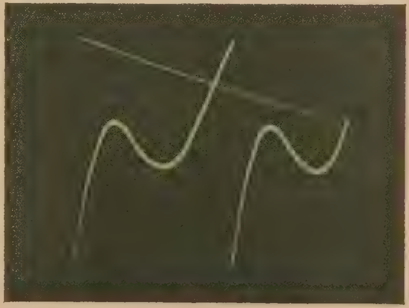


Fig. 3—All that's left of a sawtooth after the fundamental has been removed.

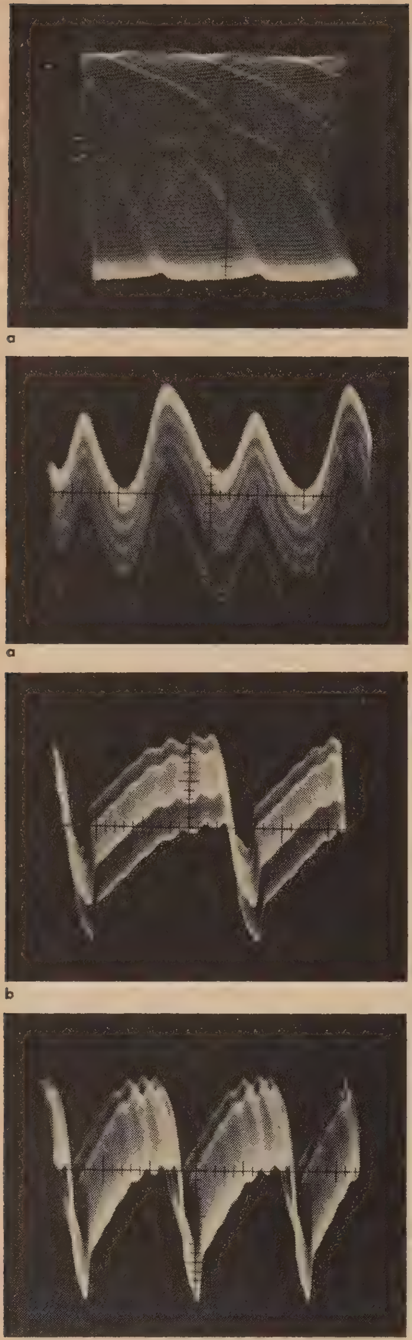


Fig. 4—Waveforms in a voltage-doubler power supply: a—normal and abnormal waveforms at a 7,875-cycle sweep; b—normal and abnormal waveforms at a 20-cycle sweep.

marked waveform changes. Displays with the scope set for 7,875-cycle sweep (Fig. 4-a), or 20-cycle sweep (Fig. 4-b), point clearly to the circuit fault.

With the scope across the filter capacitors in a voltage-doubler circuit, alternate sawtooth waves correspond to individual rectifier branches. If the circuit is symmetrical, successive sawtooth waves have the same peak voltage (Fig. 5-a). On the other hand, a weak selenium rectifier causes every other sawtooth wave to appear at reduced voltage (Fig. 5-b). We use negative sync here so the uneven peaks become more noticeable.

White noise

When we check the output of a high-gain circuit, with no signal present, our scope displays a white-noise waveform as in Fig. 6. Of course, we can never get a 100% perfect white-noise waveform. For that, we would need a circuit scope having infinite bandwidth and a perfectly flat response. White noise simply means that all frequencies from zero to infinity are in the waveform.

Zero frequency corresponds to dc. Generally we do not see a dc component on the scope screen, because scope amplifiers are usually ac-coupled This means that any dc component is rejected. When a waveform is displayed on the screen of an ac scope, its position with respect to the beam-resting level (0-volt level) shows us the positive and negative portions of the wave (Fig. 7). The positive portion appears above the 0-volt level, and the negative portion below it.

Complex waveforms are usually displayed on sawtooth deflection (linear time bases). This keeps the area of positive excursion equal to the area of the negative excursion. However, frequency response curves are generally displayed on 60-cycle sine-wave deflection. When this is done, horizontal beam travel is not proportional to time but varies from one point to the next. Hence, the beam-resting level does not divide such a waveform into equal area excursions. Nevertheless, it does indicate the positive and negative portions of the waveform.

Waveform aspects

The aspects, even of a simple sine wave, changes with the scope's sweep rate. For example, Fig. 8 shows how the aspect of a sine wave changes as the linear time-base frequency is reduced. The displays are most useful when the sweep rate is one-half or one-third of the waveform repetition rate.

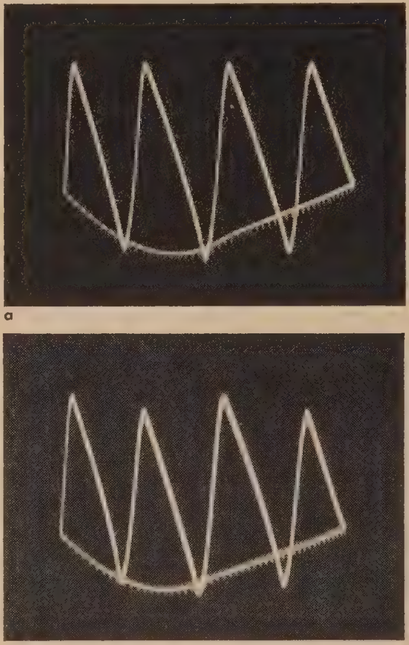


Fig. 5—Successive sawtooth waves have the same peak voltage when rectifiers and filter capacitors are normal: a—normal; b—abnormal.

Fig. 6—The output of a high-gain wideband amplifier, with no signal present, is the source of this "white-noise" signal.

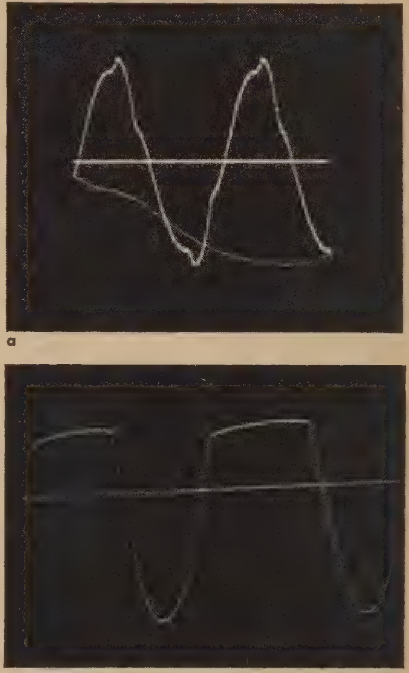


Fig. 7—Both positive and negative portions of the complex wave are displayed.

When a mixed waveform, such as a color-circuit signal, is displayed, one part may appear in detail, and another part may be highly compressed (Fig. 9). This waveform is displayed with 7,875-cycle sawtooth sweep. The 15,750-cycle portion of the waveform is seen in detail. On the other hand, the color burst and color bar portions of the waveform appear only as a blur.

The waveform used for intermodulation tests is also a mixed wave. This time, however, both components are sine waves. In general, the high-frequency component of the test wave is adjusted to a fraction of the low-frequency amplitude. Fig. 10 shows two typical instances of intermodulation distortion. In one (Fig. 10-a) the positive peak is compressed. In the other (Fig. 10-b) the negative peak is compressed.

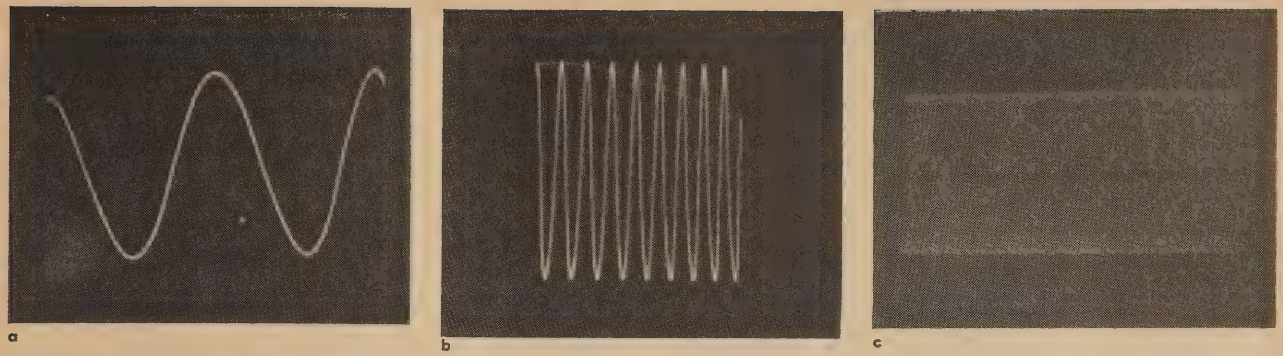


Fig. 8—a—Sweep rate equal to one-half waveform repetition rate. b—Sweep rate equal to one-ninth waveform repetition rate. c—Sweep rate very much less than waveform repetition rate.

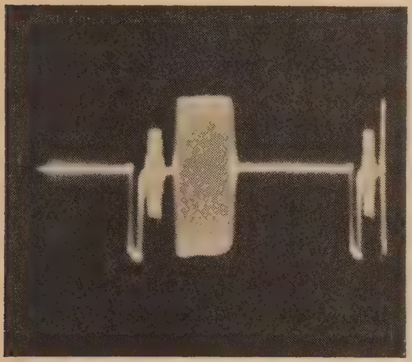


Fig. 9—A color signal is a mixed wave.

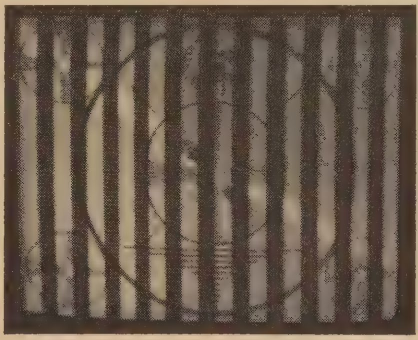


Fig. 11—This display is the result of mixing a square wave with a test-pattern.

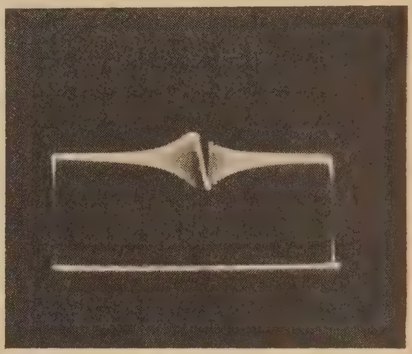


Fig. 13—Detail of marker is seen when sweep width is reduced to a minimum.

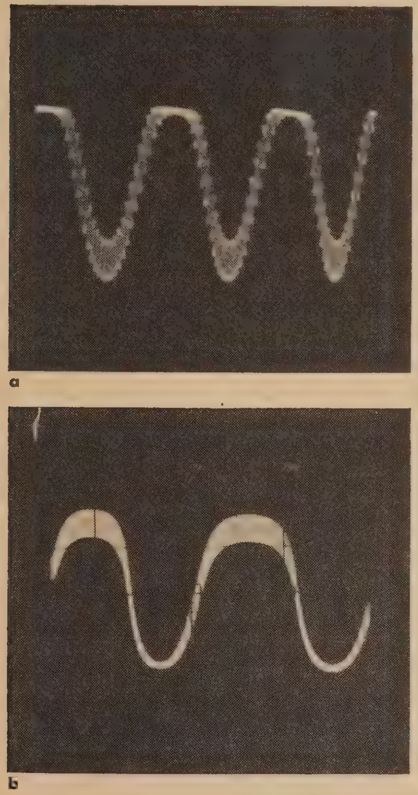


Fig. 10—a—Intermodulation distortion caused by positive-peak compression. b—IM caused by negative-peak compression.

Suppose we mix a square-wave voltage with a video signal, such as an ordinary test-pattern. The result is dark vertical bars superimposed on the test pattern as in Fig. 11. A simple linear mixer (a resistive matrix) is used for this application. A linear electronic mixer can also be used.

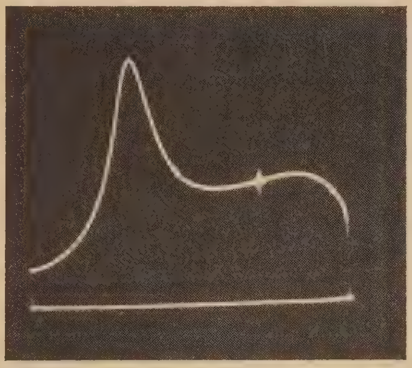


Fig. 12—Rf response curve with marker.

Marker structure

A marker and response curve are a mixed waveform. A marker on an rf curve is shown in Fig. 12. The marker has a definite structure. If we reduce the sweep width to a very small value, the marker becomes apparent, as in Fig. 13. What is the envelope shape of the marker? It is the frequency response of the scope's input circuit.

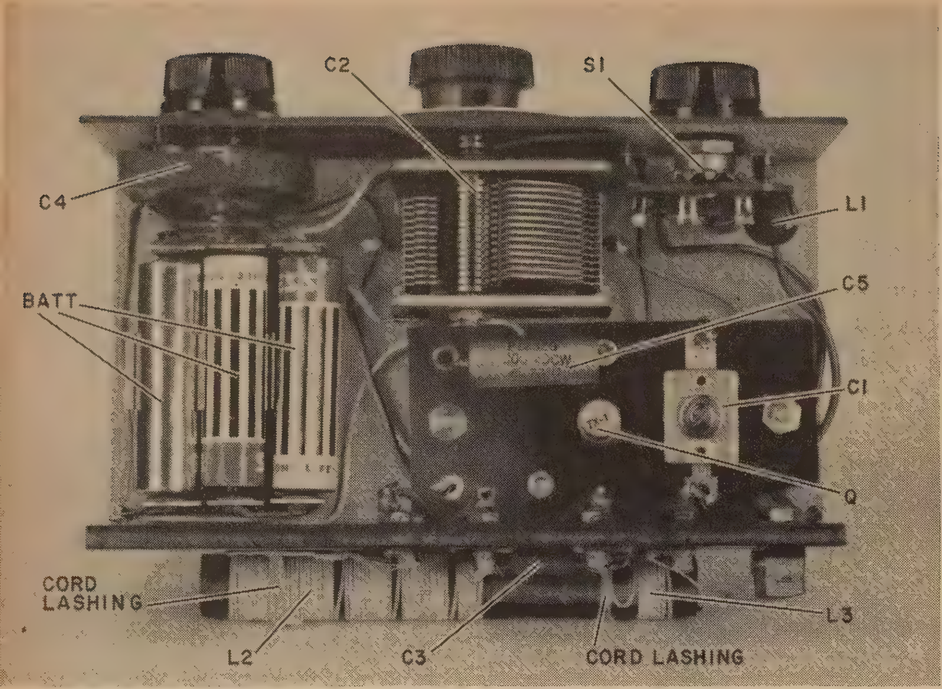
A marker is an undemodulated FM voltage. It starts at a high frequency (upper frequency limit of the scope input circuit), decreases gradually to zero frequency, and then again increases to the scope's high-frequency limit. We often use a series (isolating) resistor in the scope lead to reduce the high-frequency limit and make the marker appear sharper.

The third waveform, the cyclogram, is used to display power patterns, show the quantities of resistance and reactance in a circuit, and other things. It really needs a complete article to cover its forms and uses, and such an article will appear in an early issue. END

Equipment Cleaning Aid

When cleaning equipment it is often necessary to remove hardened paint drippings, stains, scuffs and other surface imperfections without damaging the factory finish. Chemical solvents must be used with extreme caution since they may dissolve paint or lacquer.

As shown in the photograph, an ordinary pencil kind of typewriter eraser with its attached brush makes an ideal tool for such tasks. The abrasive-filled rubber eraser will effectively remove almost any blemish. Erasing action is easily controlled and a perfect job results.—*Roy E. Pafenberg*



Autogen—1-(one) transistor radio

By WILLIAM H. GRACE, JR.

Novel regenerative set is really hot

THIS NOVEL REGENERATIVE TRANSISTOR radio does not have a conventional feedback system. The schematic shows it is neither a Hartley, Colpitts or Ultraudion. It has no tickler feedback coil, feedback capacitor or feedback tap on the inductor.

The Autogen differs from the usual regenerative receiver in several other respects too. Increasing antenna coupling does not make the set stop oscillating. Instead it enhances the tendency to oscillate, and the so-called "dead spots" and other effects of antenna resonance do not appear.

C4, the regeneration control, shunts the collector and emitter. It should be set to the point where oscillation just ceases. The detector is then most sensitive. This regeneration control is smooth and gradual, and does not alter the frequency of the tuned circuit. An occasional adjustment maintains sensitive detector action over most of the broadcast band.

Various models of this receiver have been built and tested by experimenters in several Eastern states. In every instance it earned good selectivity and sensitivity reports. A total of some 160 stations were received. I wish to thank J. D. Amorose in Richmond, and M. M. Schuman in Baltimore, for excellent dx reports during listening tests with this receiver.

Construction is simple. The few components are mounted upon a front, rear and small deck panel. These are attached to a small wood base board.

My front panel is a 6 x 3-inch piece of ⅛-inch Bakelite, but you can vary the dimensions to suit your needs and may change the component placement without harming performance, if you don't crowd the parts. Keep wiring as direct as possible and use rosin-core solder. The deck panel is also made of ⅛-inch Bakelite and is supported by two bolts from the base board. The rear panel is Prestwood.

Fahnestock clips simplify antenna and ground connections. Switch S1 is a three-position rotary which gives various combinations of antenna and ground. Select the position that gives best reception and volume. Position 1 permits the radio to function with a "grounded antenna"—for loudest signals at the high-frequency end of the broadcast band. Position 2 puts a 250-μh peaking coil in series with the ground—for best results at the low-frequency end of the band. Position 3 allows the set to be used with the antenna alone—for greatest selectivity. These statements hold true when the radio is operated with a 75- to 100-foot antenna and a good ground. However, local stations are often heard with a short antenna wire hung from a window when S1 is in position 3. Another stunt is to attach the set to the finger stop of a dial phone. Strong locals can sometimes be received if a ground wire is attached directly to the antenna post. A good antenna and ground will usually provide signal levels more than adequate for earphone reception. For loudspeaker reception try adding a stage or so of audio amplification.

Parts and assembly

The battery consists of three penlight cells connected in series. Inductances L2 and L3 are a single-layer winding in two sections. They consist of a total of 68 turns of No. 24 dcc copper wire—60 turns for the tuned circuit and 8 turns for the transistor input circuit. Both windings must be in the same direction. The larger one may be section-wound to lower distributed capacitance—see coil detail diagram.

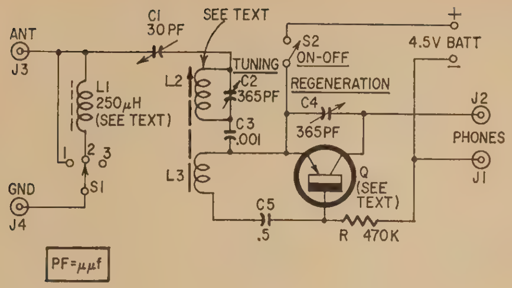
The ferrite core is ½ inch in diameter and 4 inches long. The windings start about ¼ inch from either end. The cores are obtainable from many supply houses. Cut to size by deep scoring with a file and breaking with your hands or with pliers.

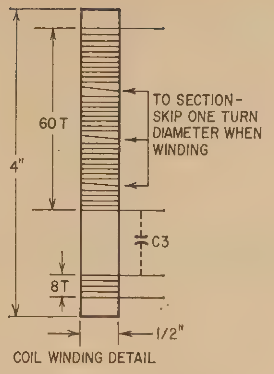
Winding is simplified if two or three turns are close-wound and anchored with a drop of quick-drying cement. Then the balance of the winding can be completed. Another drop of cement fastens the last few turns and no problems arise.

If you want to avoid coil winding, use a Lafayette MS-166 inductance. It can be modified quickly. L2—L3 is lashed to the back of the rear panel with cord.

BENCH TESTED

The Autogen receiver was tested in two locations. In New York City it received 18 stations with good volume and clarity. At a point 25 miles from New York City, 13 stations were received. The set was unusually selective for a 1-transistor radio, and regeneration control was smooth.





Circuit of the little receiver.

R—470,000 ohms, 1/2 watt
C1—30 pf, mica, trimmer
C2—365 pf, tuning capacitor
C3—.001 μf, mica or ceramic
C4—365 pf, tuning capacitor, solid dielectric type
C5—0.5 μf, paper
BATT—4.5 volts, 3 penlight cells in series
J1, J2—tip jacks
J3, J4—binding posts for Fahnestock clips
L1—250 μh peaking coil
L2, L3—see text
Q—see text
S1—single-pole 3-position rotary
S2—spst slide
Chassis, see text
Miscellaneous hardware

This inductor is mounted on the back of the rear panel to keep it as far as possible from C2's frame. Any ferrous metal close to the coil will alter its Q for the worse. All hardware is brass or copper for the same reason.

The four leads from the inductor are soldered to lugs, held by small brass bolts which pass through the rear panel just above the coil. Additional lugs under the nuts facilitate connection to other components of the set. C3 is soldered to two of these lugs on the back wall of the rear panel.

Several types of p-n-p transistors can be used. My set uses a Lafayette SP-237. Raytheon's 2N414, 2N113, 2N114 types also work and some CK768's and CK722's proved to be good oscillators in this circuit.

Some transistors will work better with somewhat higher or lower values for R—one transistor I tried would work only with 330,000 ohms. If a meter is available, measure collector current and adjust R so that the collector current does not exceed that given by the manufacturer. If you use an n-p-n transistor, reverse battery polarity.

When all parts have been assembled and wiring completed and rechecked for errors, insert the batteries in the battery holder with S2 turned to OFF. Then insert the transistor in its socket. Last, connect the antenna, ground and phones. The set is now ready for testing.

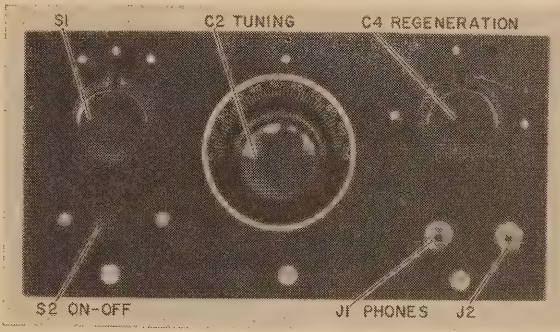
Set S1 to position 3 so the antenna alone is in circuit. Tighten C1 down to its maximum capacitance and then back off a turn or a turn and a half. Adjust regeneration control to minimum capacitance and turn the tuning dial slowly. If you hear a sound like a banshee on a toot, all is well. Next, rotate the regeneration control until the oscillation sounds cease. If they do not stop even when C4 is fully meshed, reduce the capacitance of C1 until they do. Now, reducing the value of C4 should start regeneration.

Tune in a station about mid-dial and set the regeneration control for best volume and quality. Other stations should now be heard over the dial. Test the effect of S1 and leave it set to the position giving best results for a given frequency.

If the radio does not oscillate, recheck all wiring, battery polarity and the transistor. Do not be surprised if the set does not oscillate without the antenna attached.

If you cannot stop oscillation, even with a smaller value for C1, shunt C4 with 400 pf and readjust C1 and C4. Certain transistors require more bypass capacitance than others. Note that C1 affects volume, selectivity and the tendency to oscillate. Adjust it for the best results with different-sized antennas. Once set for a given antenna, no further adjustment is required.

Happy listening! END



Autogen has a minimum of controls, and all of them are on the front panel.

Space-Age Crossbow

This laser rangefinder fires 20-foot-long "arrows" of light to determine—to within 5 feet—distances to targets. The light pulse fired from one of the twin barrels zips to the targets and is reflected. A photomultiplier intercepts the returning beam, and a computer converts the elapsed time into actual distance. Surprisingly, accuracy is constant (not a constant *percentage*) for different distances, and depends only on the length of the light pulse.

Key to this precision is a special modulator which operates at speeds around 20 billionths of a second, and chops the light beam into 20-foot pieces.

The entire unit, including power supply, weighs less than 30 pounds. Since the light pulse is so short, a tripod is unnecessary, and the rangefinder can be mounted on a rifle stock, wiht its power supply on a belt. Thus any infantryman can direct artillery fire as easily as he can fire his own carbine.

The device, called the Ranger, is a development of Raytheon's Missile and Space Division.

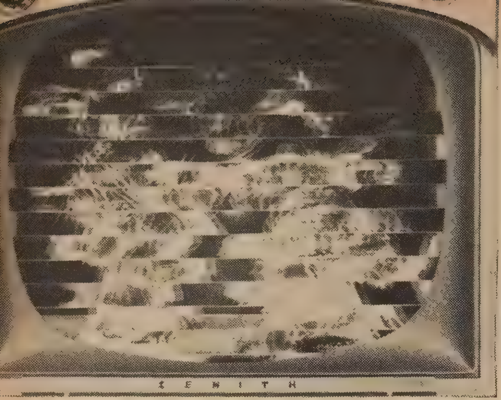


Fig. 1-a—Scrambled pictures resulting from the Zenith Phonovision system.

doing the TV SCRAMBLE

This is how pay-TV works

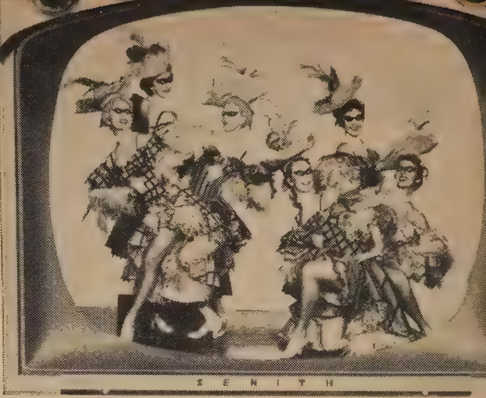


Fig. 1-b—Unscrambled picture whose scrambled version is shown in Fig. 1-a at the left.

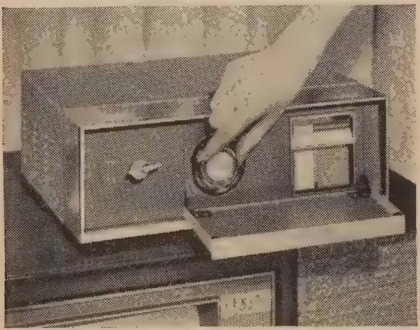
By IRA KAMEN

THE TV SERVICE TECHNICIAN WHO HAS been doing his best to give his customers a clear high-definition picture may be stumped by "scramblers" who are doing their best to broadcast TV programs that cannot be watched by viewers without decoders.

While the pay-TV scramblers are limited by the FCC to a one-city test for 3 years (Zenith in Hartford, Conn.; Teleglobe in Denver, Colo.), scrambled broadcasts are now authorized for law enforcement and medical education.

In New York City, for example, Teleglobe scrambles the "lineup" over municipal channel 31. Detectives in all precincts can view the showup of criminals without wasting time traveling to Police Headquarters. The scrambling protects the civil liberties of arrested persons since they cannot be identified by everyone watching the uhf channel.

In Jacksonville, Fla., G-E scrambles medical education TV programs transmitted over WJCT for obstetricians and general practitioners.



If you subscribe to Zenith's Phonovision system, this decoder is installed.

The FCC, under Newton Minows' dynamic leadership, has stirred many public service and educational groups into exploring the use of TV. By the time this article appears, more than five major cities will be in the operational or test stage of some form of scrambling and at least ten more will be in the planning and application stages.

Pay-TV system operators expect to offer their subscribers high-priced entertainment (first-run movies, major sporting events, Broadway plays, etc.) at a low cost, in the comfort of their living rooms. These broadcasts must be scrambled so that only those paying to see the show can tune it in.

The Zenith-Phonovision system produces the pictures shown in Fig. 1—scrambled (a), normal (b). Both picture and sound are scrambled. To tune in such a show, the viewer operates two controls on a special decoder wired to his set. He turns a rotary control knob to set up the proper index number for a given program and flips the switch to the PV position. When the viewer wants to return to normal TV again, he turns the switch to TV.

Switching of both encoded video and audio fits in with TV broadcast standards. The TV receiver's circuits are activated by the transmitted coded signals. The decoder is connected to the TV set with simple intercaptive taps and an inductive pickup.

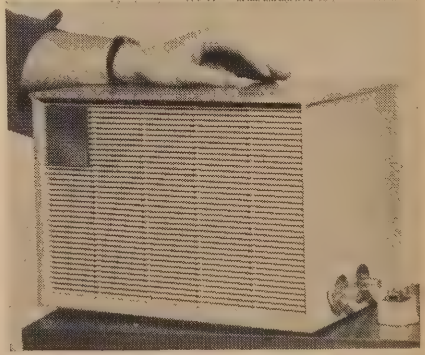
Another method

The Teleglobe system proposed for test in Denver, Colo., leaves the TV receiver completely gadget-free—there is no decoder or anything connected to the set. When a pay-TV program is on, any set owner can view the picture free over KTVR, channel 2. But only pay-TV subscribers will get the sound. An inexpensive telephone type wire line (independent of the existing telephone wires but run through the same ducts or overhead cable carriers) connects subscribers' homes with the Teleglobe subscription network. A Teleglobe speaker connected to this wire on a party-line arrangement carries the sound for the pay-TV broadcast. The subscriber simply switches the sound on when he wants to watch and listen to a program.

TELEGLOBE DECODER
CODE
NORMAL

Teleglobe's Video Security decoder sits on the top of the TV receiver.

Forthcoming pay-TV attractions are announced over the Teleglobe speaker,



Teleglobe speaker to be used in pay-TV system in Denver, Colo.

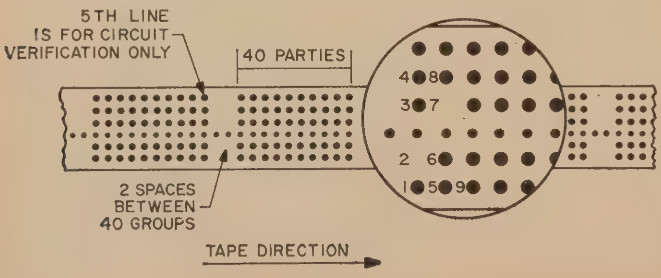

5TH LINE IS FOR CIRCUIT VERIFICATION ONLY
40 PARTIES
2 SPACES BETWEEN 40 GROUPS
TAPE DIRECTION
4 8
3 7
2 6
1 5 9

Fig. 2—Closeup of the telemetering tape used by Teleglobe.

which also plays good music for free, all day, every day.

Tests show that silencing the audio is very effective. It makes the viewer want to obtain the complete pay-TV program, yet prevents him from enjoying the show free.

As the TV set is untouched, servicing costs are not affected. The TV owner's own service technician will be the only one responsible for the set's performance on both regular and pay-TV operation.

The Teleglobe system also eliminates so-called individual "box offices" in the homes proposed by some systems (not currently filed with the FCC for test) with their encroachment upon one's privacy. Installing coin boxes or obtaining special cards for actuating a decoder is eliminated. Nor are there annoying door-to-door coin-box collectors. A central box office of the Teleglobe system handles all billings on a "per program" basis—from data furnished by a telemetering system.

Fig. 2 is a closeup of the telemetering tape used by Teleglobe. An IBM machine converts the tape to cards processed by an IBM billing system.

The Video Security system for police lineups and confidential training is also applied to special educational broadcasts for management associations and is planned for medical education and college credit courses.

In the Video Security system the video output in the transmitter is modified before modulating the rf carrier. The video is reversed in a phase inverter and then transferred to a gating circuit where video and sync are separated. The sync information is reinserted at the proper time via a mixing circuit. However, the sync is now of opposite polarity, with the sync tips in the white direction. This renders the sync separator in a conventional TV receiver useless, and the set will not sync. You get a negative picture too.

The proper decoder is the only thing that will straighten out the picture. It reverses the polarity of the video once again and reinserts the sync information in the proper sequence.

This year and in years to come, engineers, broadcasters and service technicians will be doing the TV scramble to provide additional services for uhf and vhf TV as well as exploring the advancement of pay TV.

As Newton Minow said in a recent statement before the 40th Annual Convention of the National Association of Broadcasters: "Pay-TV has been a matter of controversy for more than 10 years. It deserves the verdict, not of the commission's chambers, but of the market place. The final decision should be in the hands of those who build and create, and those who watch and listen." END

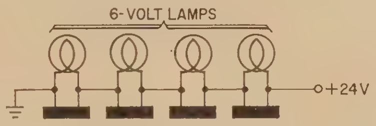
WHAT'S YOUR EQ?

Three puzzlers for the student, theoretician and practical man. They may look simple, but double-check your answers before you say you've solved them. If you've got an interesting or unusual answer send it to us. We are especially interested in service stinkers or engineering stumpers on actual electronic equipment. We are getting so many letters we can't answer individual ones, but we'll print the more interesting solutions (the ones the original authors never thought of). We will pay $10 and up for each one accepted. Write EQ Editor, Radio-Electronics, 154 West 14th St., New York, N. Y.

Answers for this month's puzzlers are on page 71.

Four-Bulb Puzzler

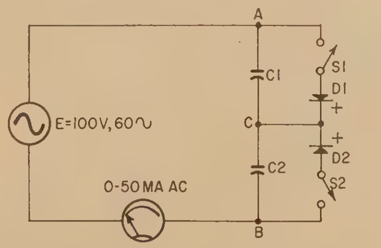
Each black box in the diagram contains a single electronic component, connected in parallel with a 6-volt bulb. If one bulb burns out, the others remain lighted—the black box across the extinguished bulb carries the load and the total current is reduced slightly. What is in each black box? (The black boxes do not contain any of the following: fixed resistor; capacitor; relay or other electromechanical device.)—*Kendall Collins*



Simple circuit?

In the circuit shown, an alternating voltage E of 100 rms, 60 cycles, is connected to two capacitors, C1 and C2, in series. First, let C1 and C2 be equal, each having a capacitance of 2 μf. The series combination has then a value of 1 μf, which at 60 cycles will have a reactance of 2,650 ohms. The alternating current flowing in the circuit will be approximately 38 ma.

Closing switches S1 and S2 places diodes D1 and D2 across capacitors C1 and C2, respectively. Note that the diodes are connected back to back!



1. If S1 and S2 are both closed, will this change the reactance of the circuit, compared to the case when the switches are open? In other words, will the alternating current change?

2. What will a high-resistance dc voltmeter read, when placed across C1 and then across C2?

3. If only one of the switches, say S1, is closed, what will be the effect on the reactance—that is, on the alternating current?

4. And what will the dc voltages be across C1 and C2 with only S1 closed?

Better not be too sure that you know all about such a simple circuit! It might be smart to set up the circuit and measure the values. Chances are you won't believe what you find!

—*Walter Richter*

Ohms, sweet ohms

Didn't know resistors could amplify, eh? Well, watch. With the switch in position A (Fig. 1), 10 volts will be applied across the 10-ohm resistor, giving us a current of 1 ampere. The power by P = EI will be 10 × 1 = 10 watts. When we switch to position B, 1 volt across 10 ohms will give us 0.1 amp, and a power of 1 × 0.1 = 0.1 watt. Now let's find the power when both batteries are used (Fig. 2).

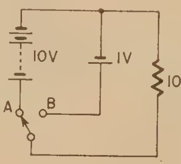


Fig.1

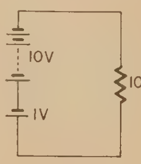


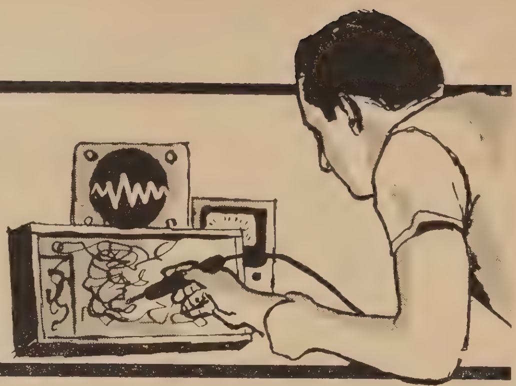
Fig.2

Eleven volts across 10 ohms gives us a current of 1.1 amps, with the resulting power of 11 × 1.1 = 12.1 watts. But hold it! The 10-volt battery delivers 10 watts, and the 1-volt battery 0.1 watts, making for a total of 10.1 watts. Yet the combination gave us 12.1 watts! Where did the 2 watts come from?

—*John Timar, Jr.*

SERVICE CLINIC

By **JACK DARR**
SERVICE EDITOR



This column is for your service questions. We answer them free of charge and your name and address will be kept confidential if you wish. The main purpose is to help those working in electronics with their problems.

We've changed our target a little and are no longer restricted to TV, Radio, audio and industrial electronics problems are also grist for the mill. All letters get a prompt individual answer and the more interesting ones will be printed here. So if you have a service problem, send it here. We'll do our best to help you solve it.

PICTURE TUBES ARE ALL VERY MUCH alike. Each one has a big glass bottle, electron gun, etc. The only real difference is the faceplate size and the deflection angle. Looking at the multitude of types in a picture-tube list, you'll wonder, and then be surprised to find out how many of them are actually interchangeable.

Recently, tube manufacturers have begun issuing lists showing how many types can be replaced by a single tube. This simplifies picture-tube replacement problems. The latest list from one major tube maker shows 30 types, which will replace a total of 167 others. So the next time you get a picture-tube replacement job, study these lists. You'll find it a lot easier than it used to be, when we thought we *had* to replace with an exact duplicate.

The major factor, of course, is the deflection angle. We *must* use a tube with the same deflection angle and faceplate size as the original. The only exceptions are the old 16- and 17-inchers. These tubes are so close in size that they can often be used interchangeably. (Of course, this does not include the newer, narrow-neck button-base tubes.) Most of the time you'll be trying to use a 17 for a 16, because the 16's are often rare and higher priced.

High voltage is not nearly as important as we used to think. If the high-voltage supply is in good shape, you'll find that most tubes will still give ample brightness, even though the high-voltage *rating* may be off several kv.

Type of focus used on the original tube may cause some changes, but normally not serious ones. If the original is electromagnetic focus, you can always replace with an electrostatic focus tube. If a PM focus magnet is used on the original, take it off. If a focus coil is used, simply take it off the neck and leave it lying in the cabinet. If it is a shunt type, connected directly across the B-plus supply, disconnect it. This will remove some of the load from the power supply. Check your B-plus voltages. If the coil is used in series, as a filter choke, you can replace it with a 5-henry choke. Focus controls can be disconnected. You can pick up voltage for electrostatic focusing almost anywhere in the B-plus circuits, since the current drawn is negligible.

Watch out for total length in some of the older tubes. This can upset the mounting if the cabinet is a bit short. Almost all of the older types used a 7-inch neck, but total length varies quite a bit with bulb shape. You can usually get by with a shorter tube, but not with a longer one.

Faceplate shape is important in one type that I can think of at the moment, and possibly in others. This is the 21FP4 series. They had a cylindrical faceplate, shaped like half a barrel. The standard hemispherical faceplates won't fit the masks properly, so watch out for this. These are found mostly in old DuMonts and Zeniths.

The serviceman's friends, the metal-shell picture tubes, can and should be replaced with their glass equivalents.

Conversion kits are available for mounting the glass tubes, since the physical mounting is the only difference. 21MP4's can be replaced by 21YP4's, and 21AP4's by 21ZP4's. This is always a favorite with the technician, since it gets rid of that exposed metal shell loaded with kilovolts. Customers like it too. The glass replacement is usually much less expensive than the metal equivalent.

Replacement procedure

The actual procedure is very simple. Everyone has, or ought to have, a tube manual. These handy books list all current picture-tube types, giving size, deflection angle, base connections, voltages and so on. So look up the original tube. Make a note of its major characteristics—size and deflection angle—and then start looking. You'll find many duplicates, even with the later 90° tubes. For example, a 21FLP4 will replace any of the following tubes: 21ALP4, 21ANP4, 21ATP4, 21BAP4, 21BNP4, 21BTP4, 21CBP4, 21CMP4, 21CVP4, 21CWP4 and 21DNP4. I think this is the champion, but there are others which cover almost as wide a range.

You should check that the basing is identical. You may find one small difficulty in replacing an electromagnetic focus with an electrostatic focus tube. The socket may be a partial, with only pins 1, 2, 10, 11 and 12. To make a connection to pin 6 for focus, take a connector out of a discarded tube socket, solder a wire to it and cover the connector with a piece of spaghetti. This can be connected to a source of focus voltage anywhere in the set. An easier way is to use one of the small sheet-metal links which slip over pins 6 and 10 or pins 6 and 1 (usually ground). In emergencies, a piece of bare solid hookup wire does the job just as well.

So in any job where the right picture tube isn't immediately available, get out the tube book, some scratch paper and start looking. Incidentally, a price list can also be used to good advantage. Many times you'll be able to find a more popular tube type that lists for a lot less than the original. This never makes a customer unhappy. Final psychological note: If you do interchange, it's a good idea to keep it to yourself. There are some customers who will blame everything that happens during the next 5 years on the fact that you put in the *wrong* tube!

Heater trouble

The trouble is loss of heater voltage on both multivibrator tubes in an Admiral 15C1 chassis. It works for a few minutes then both of these heaters go out. There must be an open circuit somewhere. I tried a 12-volt filament transformer on them, and the set works.
—W. R., Braddock, Pa.

This is not an *open* circuit. This

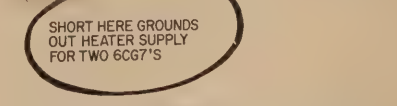
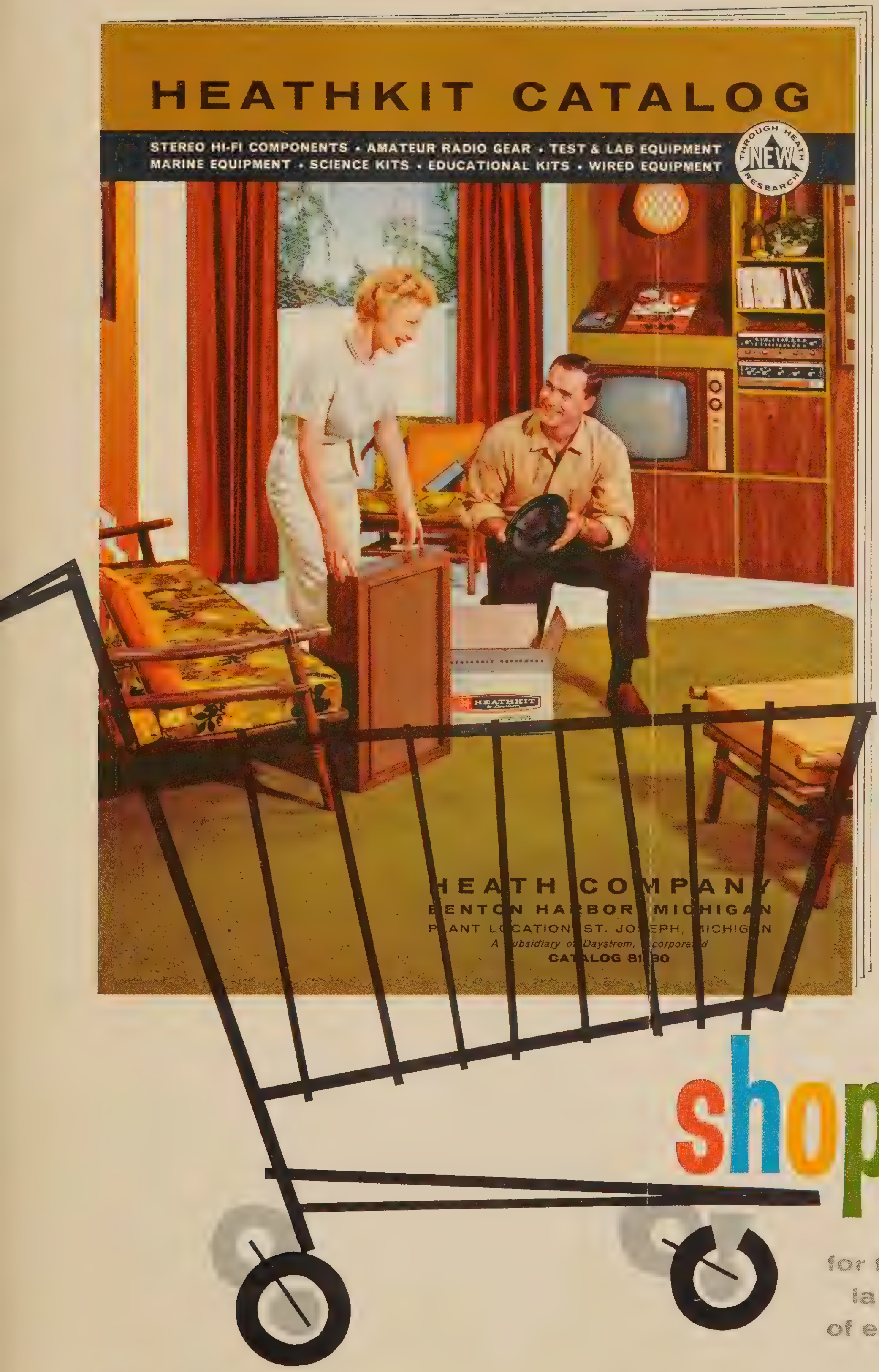


Fig. 1—Heater-cathode short in a series-string will kill voltage to all tubes in the string following the shorted one.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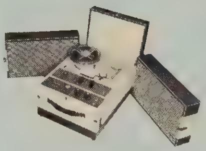

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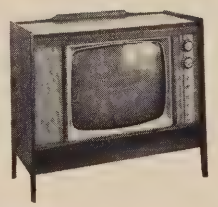

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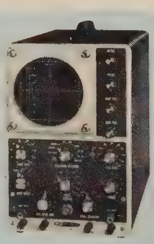

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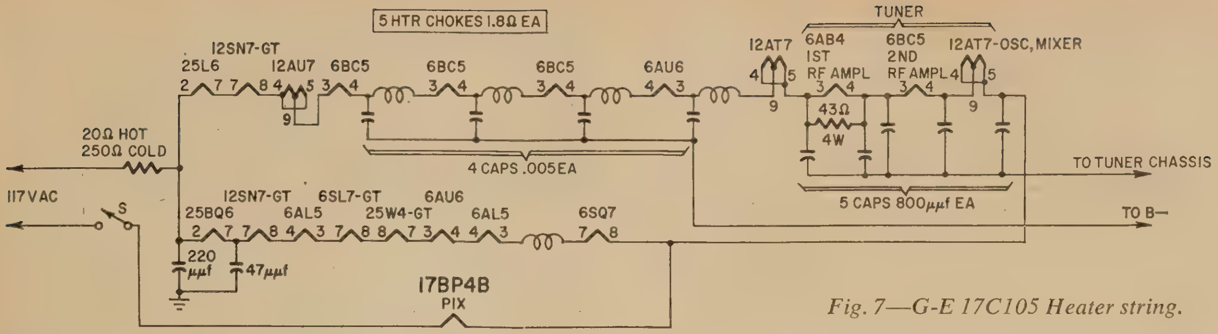


Fig. 7—G-E 17C105 Heater string.

chassis has a series-string heater circuit. There are two or three things that could be causing this. The most likely is a heater–cathode short in the 3BC5 rf amplifier (Fig. 3). Since the multivibrator 6CG7's are the last tubes in the string, a short in the 3BC5 or the feedthrough capacitor, or even in the interconnecting wiring, will ground out the heater supply.

Narrow picture

A Motorola 12T1, chassis TS-23, has a very clear picture, but it's about ¾ inch narrow at each side, and I can't get it to cover the screen.—T. F., E. Detroit, Mich.

This is a common complaint, and there are lots of ways to cure it. Replace all the tubes in that circuit at the same time. First the 6BQ6, 6SN7 and the 6W4. If this doesn't do it, try replacing the 6BQ6 with a 6DQ6. This will often do the trick, as the —DQ6 is just a wee bit hotter than the —BQ6.

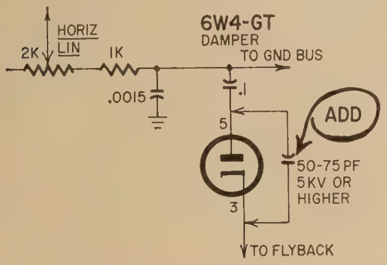


Fig. 2—Adding a small capacitor across damper tube will widen picture on TV screen.

If this doesn't help, add a small capacitor across the damper tube, from plate to cathode (Fig. 1). Use about 50–75 pf. A unit rated at 5 kv or better will usually do. Try various values until you find the one that gives you just the right amount of added width.

Split picture

I've got a split picture in a Zenith 16G23, but it isn't a regular one! The picture is divided about 70-30 with the blanking bar visible on the right side of the screen. So, I changed the 6GH8 horizontal oscillator and all of the parts I could think of in the horizontal afc circuit, and I've still got this odd-ball split picture! It's stable, but I can't get it to lock in as it should.—P. D., Hampton Park, L.I., N.Y.

Since you've replaced all of the parts in the afc, the trouble must lie elsewhere. Try replacing or substituting electrolytic filter capacitors, especially the four-unit electrolytic Zenith calls C20. This has sections in the agc, sound and video amplifier circuits, and has been known to cause similar troubles. Not from opening up, but from a very small feedthrough or leakage between the individual units of the multiple capacitor.

Best check for these is to disconnect all but one of the sections, and hang replacement units of approximately the same value temporarily in place.

Fixed brightness

The owner said he had no picture on this Raytheon M-1750. On the bench, I can get a picture, but the brightness control has no effect. I can't turn the raster off at all.—F. M., Camden, N. J.

This is a heater–cathode short in the picture tube. Since the brightness control in this chassis is in the cathode, you can't get enough bias on it to cut off the beam.

Remedy: install a transformer type brightener set for isolation instead of boost. This will isolate the short and allow the brightness control to work. Be sure to set the brightener for series heaters since this set uses a series-string heater circuit.

Tuner replacement

I have experienced quite a bit of trouble with the tuner on a G-E 17C-105. The worst difficulty is worn-out wafers in the switches.

I would like to replace this with a more sensitive tuner. Please tell me which of the replacement tuners will fit both electrically and physically.—S. W. F., Oxford, Ala.

I believe one of the Standard Coil GG series tuners would be about your best bet here. The major problem will be finding sufficient space to mount a replacement tuner on this small chassis. Be sure to check all dimensions carefully before you start!

This set has a dual filament string; two 300-ma series strings, with the picture-tube heater in series with the pair of them (Fig. 7). These tuners require 6.3 volts at 600 ma for any of the models listed. You'll be taking out three tubes requiring 18 volts at 300 ma, therefore replace these with an equivalent resistance, 60 ohms at about 7 to 10 watts. (I'd mount this on one of the yoke brackets, which are just behind the tuner, for best cooling.)

Connect the new tuner heaters in series with the CRT heater (Fig. 8)—an extra 6 volts here will make no difference. It would be a very good idea to measure the filament voltage to be certain that it is OK.

The i.f. connections are fairly simple. The original tuner is capacitance-coupled to the first video i.f., as is the new one. Connect a short piece of coaxial cable to the 6BC5 (first video i.f.) grid connection, terminated with a phono plug to fit the output socket on the new GG tuner. Don't make this any longer than is necessary, to avoid adding excess capacitance here.

I'd recommend running a complete sweep alignment after the conversion is completed. If the equipment is not available, tune the first video i.f. transformer (on the tuner) to about 45.0 mc or whatever frequency is specified in the original alignment instructions. It will be very close to this. END

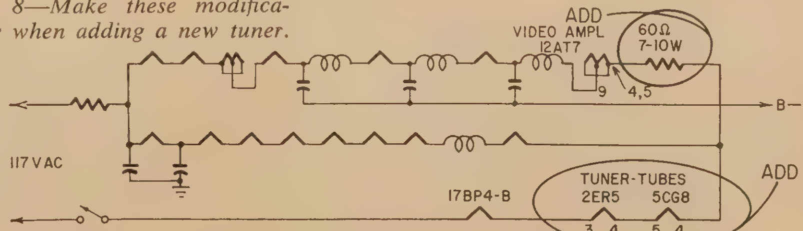
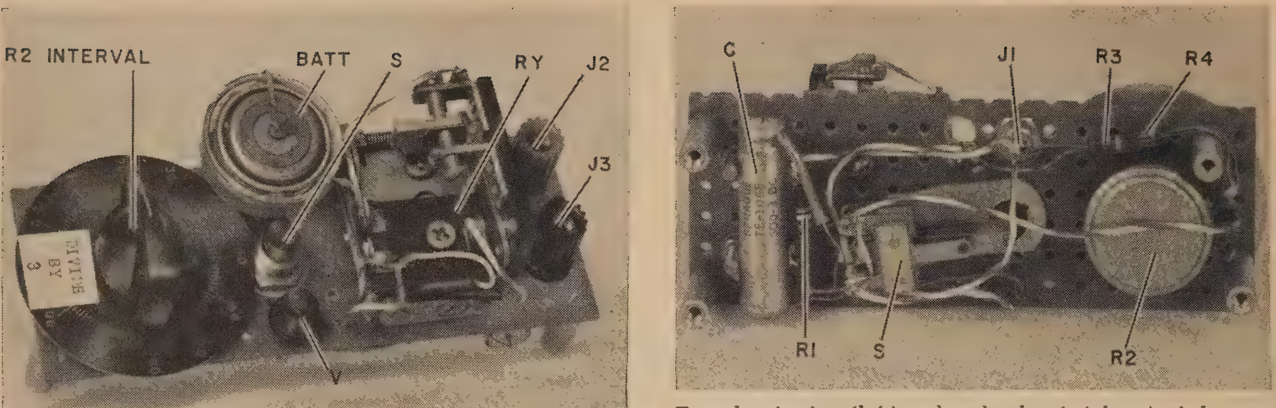


Fig. 8—Make these modifications when adding a new tuner.



Top-chassis view (left) and underchassis (above) of the continuously rising current supply.

Unusual Current Sources

One delivers a constant, the other a constantly increasing, current

By I. QUEEN
EDITORIAL ASSOCIATE

One of these two unusual current sources supplies current that climbs gradually and uniformly from zero to its peak. The other supplies a preset constant current. Both circuits are simple and use inexpensive transistors.

The uniformly rising current source may be used for timing because of its linearity. It has several advantages over other timers:

1. A relatively small time constant (R-C) is sufficient.

2. Both the relay current and the dial calibration are linear.

3. The power supply can be as low as 1.2 volts.

R1—39,000 ohms
R2—pot, 10,000 ohms, linear
R3—1,500 ohms
R4—3,300 ohms
All resistors ½-watt 10%
BATT—1.2 or 1.5 volts
C—500 µf, 3 volts, electrolytic
J1—phono jack
J2, J3—binding posts
P—phono plug
RY—spdt, 1,000-ohm coil (Sigma 5F or equivalent)
S—dpdt pushbutton switch (Mallory 1016 or equivalent)
V—2N107
Chassis—1¾ x 4¾-inch perforated phenolic board
Transistor socket (1)
Miscellaneous hardware

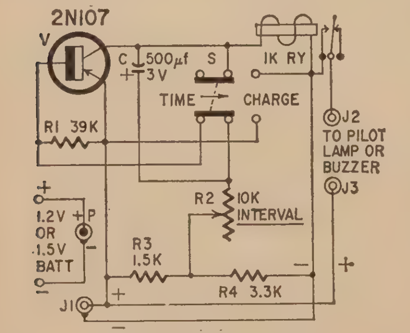
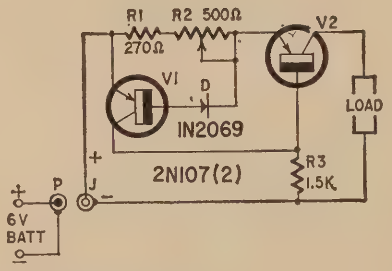


Fig. 1—The steady-rise supply.



R1—270 ohms
R2—pot, 500 ohms, linear
R3—1,500 ohms
All resistors ½-watt 10%
BATT—6 volts
D—1N2069
J—phono jack
P—phono plug
V1, V2—2N107
Chassis—1⅝ x 1⅛-inch perforated board
Miscellaneous hardware

Fig. 2—Two-stage constant-current supply.

In Fig. 1, pushbutton switch S is normally in the TIME position. When depressed to CHARGE, capacitor C is inserted directly across the power supply and charges almost instantaneously. The timing interval begins when the pushbutton is released.

C discharges through R2, R3 and V (which is forward-biased by R3, R4). Normally we would expect an *exponential* discharge, most of it occurring at the beginning. Instead, the drop through R2, R3 drives the transistor base more positive than the emitter and regulates the transistor's conduction in proportion to the discharge. This feedback results in a *gradual* rise in conduction. Also, it greatly prolongs the discharge time. Up to 35 seconds or more may be timed with an R-C constant of only 5.

The table shows the relationship between relay voltage and elapsed time after discharge begins. Compare the nearly perfect *linearity* with the exponential charge or discharge of conventional timing circuits.

Because of the excellent linearity, dial calibration may be direct-reading. I used a 0–100 dial with uniform markings and set the relay to pull in at 33 seconds (which happened to be at 0.87 volt). This gives me a 3-to-1 ratio between dial and time throughout the scale. For example, I set the dial at 75 if I need a 25-second interval, etc.

R2, the INTERVAL control, must, of course, be a linear pot. For larger intervals increase C or R2 or both.

Constant-current generator

Look, Ma, no variation! Watch the meter—you will see that changes in load or input voltage have negligible effect on the current.

For example, 1 ma can be maintained with any load from 0 to 5,600 ohms. Higher current values can be maintained, too, but over a correspondingly smaller load range. If the input is

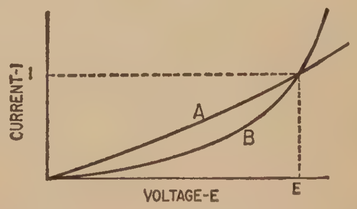


Fig. 3—Circuit characteristics. Curve A indicates linear variation of voltage with changes in current. Curve B shows the diode characteristic. Both refer to the circuit in Fig. 2.

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Such perfection of reproduction means that listeners at home, using home type components, can truly have concert hall realism — a level of fidelity of reproduction which cannot be improved regardless of how much more money were to be spent on the components used. This is truly reproduction for the audio perfectionist, and all Dyna components are of a quality level which permits reproduction indistinguishable from the original. This is achieved through exclusively engineered designs coupled with prime quality components. Further, the unique designs and physical configuration of all Dynakits make them accurately reproducible, so that everybody can hear the full quality of which the inherent design is capable. Dynakits are the easiest of all kits to build—and yet they provide the ultimate in realistic quality sound.

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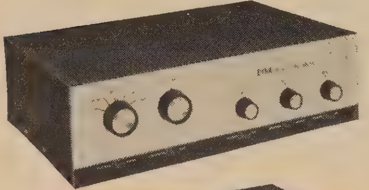
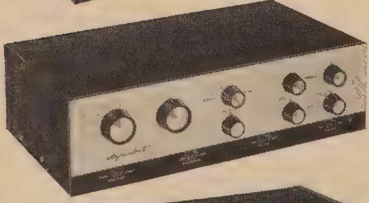


★SCA-35—Integrated stereo amplifier and preamplifier with low noise, low distortion, and moderate power output. 17.5 watts per channel continuous (45 watt total music power) with less than 1% distortion over the entire 20 cps to 20 kc range. Unique feedback circuitry throughout. Inputs for all hi fi sources including tape deck.
SCA-35 kit **$89.95**; wired **$129.95**



PAS-2—Fully flexible stereo preamplifier with less than .1% distortion at any frequency. Wide band, lowest noise with every necessary feature for superb reproduction. Acclaimed throughout the world as the finest unit available.
PAS-2 kit **$59.95**; wired **$99.95**

★STEREO 35—A basic power amplifier similar to that used in the SCA-35. Extremely low distortion over entire range at all power levels. Inaudible hum, superior transient response, and outstanding overload characteristic makes this unit outperform components of much higher nominal rating. Features new type Dynaco output transformer (patented design). Fits behind PAS-2 or FM-3A units.
ST 35 kit **$59.95**; wired **$79.95**

STEREO 70—One of the most conservatively operated and rated units in the industry. The Stereo 70 delivers effortless 35 watts per channel continuous power. Its wide band Dyna circuit is unconditionally stable and handles transient wave forms with minimum distortion. Frequency response is extended below 10 cps and above 40 kc without loss of stability. This amplifier is admirably suited to the highest quality home listening requirements with all loudspeaker systems.
ST 70 kit **$99.95**; wired **$129.95**

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Relationship of time in seconds to voltage across relay when R2 is set for maximum resistance.

Seconds	Volts
5	0.14
10	0.28
15	0.42
20	0.56
25	0.68
30	0.80
35	0.90
40	0.99

changed from 6 volts to 9, the output rises only 5% or less.

Fig. 2 shows the two-stage regulator. The transistors are inexpensive types. Current may be set for any value from 0.9 to 2.4 ma by R2, and the chosen value will be maintained. For high currents (to 10 ma or more) reduce the value of limiting resistor R1.

This current source may be used to power transistor circuits. The transistors or other components cannot be damaged because current remains constant even under a *short-circuit.*

The load current flows through V2 and also R1, R2. D is biased by the voltage across these resistors. Line A (Fig. 3) indicates the linear variation of voltage across the resistors as current varies. Curve B shows the diode characteristic. For example, if the load current were doubled, the drop across R1, R2 would also double, but the diode voltage would rise little if any. The remainder of the rise would appear as bias for V1. Thus the load current controls V1's bias, a greater current driving V1 to greater conduction, etc.

If V1 passes more current through R3, reverse bias at V2 increases. Therefore, V2's internal resistance will increase and tend to cancel the original increase in load current.

An interesting application of the circuit appears in Fig. 4, a *linear ohmmeter*. The dc voltmeter measures voltage drop across R. Since current remains constant, the voltage is proportional to resistance. Thus if the generator is set for 1 ma, each volt signifies 1,000 ohms, 0.87 volt means 870 ohms, etc. Such an instrument provides more reliable and precise readings than a conventional ohmmeter.

The instrument can be used to compare or calibrate current meters. In other words, once set correctly, it is a portable current standard.

Both these circuits are based on recent patents. As is often the case, they do not disclose specific component values or transistor types. Experimental models were constructed, and values worked out for inexpensive transistors. The first circuit is based on patent No. 2,947,881, and the second on patent No. 2,978,630. END

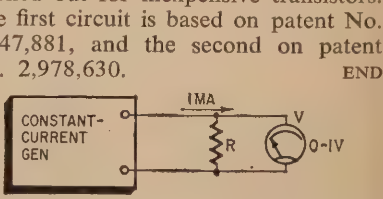


Fig. 4—Basic circuit of linear ohmmeter using constant-current supply.

EQUIPMENT REPORT

Sweep Circuit Analyzer and Transistor & Circuit Tester (Sencore SS117—EICO 680)

YOU MAY HAVE THOUGHT AT FIRST glance, as I did, that the SS117 was the same sweep circuit analyzer Sencore had been marketing for 2 or 3 years A closer look shows that this unit is a vastly improved and expanded version of the old SS105. It has a larger and more sensitive meter, makes peak-to-peak readings with a built-in vacuum-tube circuit, measures second-anode voltage to 30 kv with a special probe. The internal substitute oscillators have more output, and the exact amount can be read on the meter by depressing a pushbutton. An ac signal is brought out to jacks on the panel. It will drive a vertical yoke for full scan.

The new unit has a continuously adjustable substitute horizontal yoke winding instead of the three-position switch in the older unit. Both screen voltage and cathode current of the horizontal output tube are read at the push of a button when a special adapter is inserted under the horizontal output tube. Most functions are independent, so you can substitute for one part of the circuit while making measurements in another.

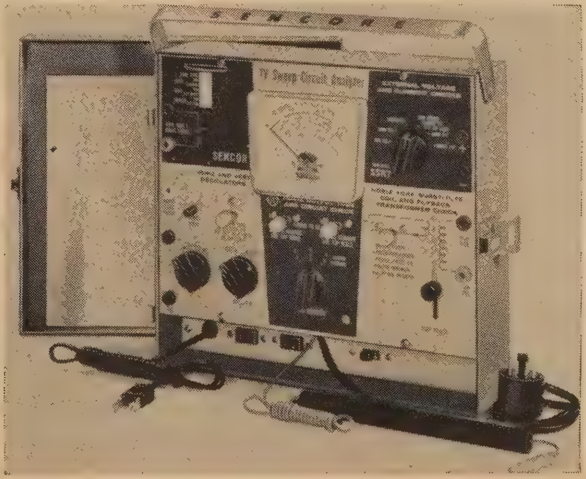
A 6CS7 is used as a horizontal or vertical oscillator substitute. As a horizontal oscillator, the first half of the tube acts as the oscillator section and the other half as an output stage At full amplitude, the horizontal circuit delivers 300 volts peak to peak. The horizontal oscillator can be locked in through the HORIZ SYNC INPUT jack with either a positive or negative signal. For most tests this isn't necessary since the oscillator runs close to 15,750 cycles without sync, providing ample output for driving the output stage and producing high voltage, but of course the picture won't be locked in. The external sync terminal is valuable to determine whether the *sync* stages can lock the horizontal oscillator, when the trouble is lack of horizontal hold.

With the OSCILLATOR switch set to VERT, the 6CS7 is converted into a substitute vertical oscillator circuit. This circuit is locked in and excited by the power-line frequency. Maximum peak-to-peak output of the vertical circuit is about 280 volts.

Troubleshooting

The whole idea of this instrument is to let you make dynamic (set-on) checks in both horizontal and vertical sweep circuits. This feature is particularly important since many troubles occur only when voltage is actually being supplied to the circuits.

Suppose we have a set that has no high voltage and, of course, no raster. Obviously, the trouble could be anywhere from the high-voltage rectifier to the horizontal oscillator.



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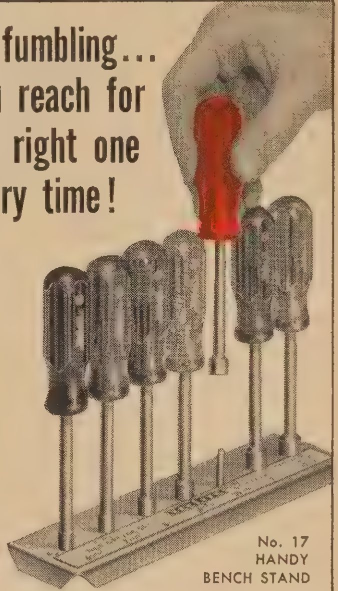

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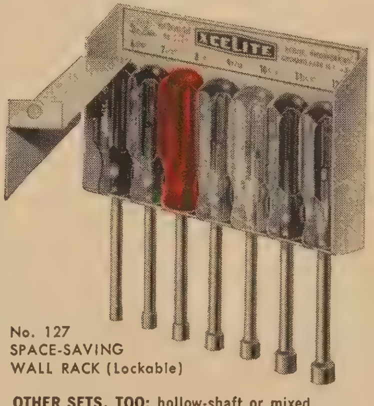

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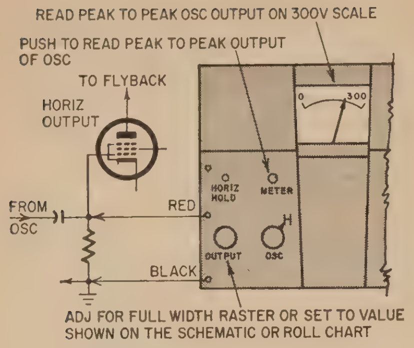
READ PEAK TO PEAK OSC OUTPUT ON 300V SCALE
PUSH TO READ PEAK TO PEAK OUTPUT OF OSC
TO FLYBACK
HORIZ OUTPUT
0
300
HORIZ HOLD
METER
FROM OSC
RED
OUTPUT
OSC
H
BLACK
ADJ FOR FULL WIDTH RASTER OR SET TO VALUE SHOWN ON THE SCHEMATIC OR ROLL CHART

Fig. 1—Using SS117 to substitute for horizontal oscillator.

To divide the circuit and tell which way the trouble might lie, insert the SS117 adapter socket under the horizontal output tube. If the cathode current is high, we can check the screen voltage to see if it is about normal, as indicated on the roll chart in the upper left-corner of the instrument. If the screen voltage *is not high,* we would suspect that the horizontal oscillator might not be working, and not supplying any negative grid bias to the horizontal output tube.

We could read the peak-to-peak output by connecting the external meter leads to the grid circuit. To be even more certain, switch the SS117 to horizontal oscillator and take the output from the jacks marked OUTPUT. This voltage is applied to the grid of the output tube (Fig. 1) either through the output tube-adapter socket which has external grid pins or directly into the circuit underneath if the chassis is out of the cabinet.

The OUTPUT control is then turned up until the high voltage does or does not return. The actual peak-to-peak voltage being injected can be read on the meter by depressing a pushbutton on the panel. This is important since a short in the grid circuit will be indicated by your not being able to get the output voltage up at any setting of the OUTPUT control.

SPECIFICATIONS

Power required—117 volts ac, 15 watts.

Dc voltmeter—300- and 1,000-volt scales.

Peak-to-peak vtvm—0–300 and 0–1,000 volts.

Dc ma—0–300 ma.

Vertical oscillator—output: 0–280 volts peak to peak, unloaded. Sawtooth waveform.

Horizontal oscillator—output: 0–300 volts peak to peak. Sawtooth waveshape. Can be locked in with external sync signal if desired.

Meter—3½ inches; 300 μa. Three scales, linear 0–300 and 0–1,000. One calibrated in degrees of deflection for flyback test.

Special features—adapter plug for horizontal output tube reads cathode current and screen voltage. Roll chart gives operating data for various horizontal output tubes. Variable substitute yoke inductance (5–40 mh). Comes with 5 leads and high-voltage probe. Test-lead compartment.

Detachable mirror lid on all-steel case. Case size 10 x 9½ x 3⅝ inches.

Price—$89.50 complete.

If substituting the oscillator does not restore high voltage, we must assume that the trouble is somewhere after the output tube. One possibility is a defective yoke. This is why the SS117 has a substitute horizontal yoke winding brought out to separate jacks on the front panel. Simply disconnect the set's yoke from the flyback transformer and connect the substitute winding to the same terminals on the flyback. Use the high-voltage probe to measure the second-anode voltage, set the YOKE ADJUST for maximum high voltage (Fig. 2). If ample high voltage returns, the set's yoke was defective. If the high voltage does not return, you are ready to check the flyback.

Leave the substitute yoke connected for this test. Push the flyback test button. This connects a coil on the substitute yoke winding through a diode to the meter. The meter has a scale calibrated in degrees of deflection. If the meter deflects to the correct deflection angle (or higher) for the set you are testing, the flyback is OK. If the meter reads low or not at all, the flyback is defective—the exception being that there is no external boost loading, such as a shorted vertical output tube in some sets, or no flyback loading, such as a shorted width coil or capacitor. As a final check, disconnect all circuits that could possibly cause loading. If disconnecting some part brings the meter up to normal, that part is defective.

Vertical circuit troubles

The SS117 also checks vertical sweep circuits. The vertical oscillator can be used to drive the vertical circuits, substituting for or bypassing almost anything in the vertical circuit. A yoke drive signal is available at the front panel; if you suspect the vertical yoke, just connect this drive voltage to it. You should get full-scale deflection on most 21-inch or smaller sets. Obviously, if you get little or no deflection, the yoke winding can be considered defective. This drive signal will not produce full deflection if the output transformer is left connected in the circuit, but you can still make a valid check without having to disconnect any wires. Just remember that deflection will only be about half as great (Fig. 3).—*Wayne Lemons*

The EICO 680

WITH THIS ONE PIECE OF TEST EQUIPMENT, the EICO model 680 Transistor and Circuit Tester, a technician should be able to repair many defective transistor radios. The unit combines an accurate transistor checker with a low-range vom. First, the technician checks the transistors in the radio. If they are OK, he goes on to measure resistance, voltage and current in the circuit to localize the defect.

Transistors are checked for leakage and beta. Diodes are checked for front-to-back ratio. The schematic shows the tester's circuit. For collector-to-base leakage, resistor R4 is switched in series with the transistor base. Should a power transistor be checked, R2, a smaller resistance, is placed in series with the base. Leakage is read on a milliammeter in the circuit. When checking collector-to-emitter leakage, R2 is connected in series with the emitter and leakage is read on the milliammeter. In the first test, the emitter is left open; in the other, the base is left open. The series resistors protect the meter should the transistor being tested have a dead short. Collector-to-base leakage should be less than 20 μa for small-signal transistors and less than 300 μa for power transistors. For collector-to-emitter leakage, small-signal transistors should read less than 1 ma and power transistors less than 150 ma.

In the dc beta test, R17 is adjusted

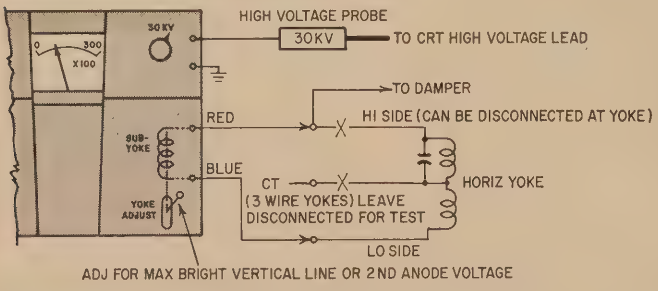
30 KV
HIGH VOLTAGE PROBE
30KV
TO CRT HIGH VOLTAGE LEAD
0
300
X100
TO DAMPER
RED
HI SIDE (CAN BE DISCONNECTED AT YOKE)
SUB-YOKE
BLUE
CT
HORIZ YOKE
(3 WIRE YOKES) LEAVE DISCONNECTED FOR TEST
YOKE ADJUST
LO SIDE
ADJ FOR MAX BRIGHT VERTICAL LINE OR 2ND ANODE VOLTAGE

Fig. 2—How to substitute for the horizontal yoke when checking for a possible defect.

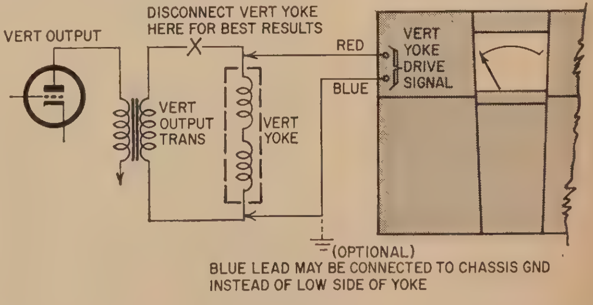
VERT OUTPUT
DISCONNECT VERT YOKE HERE FOR BEST RESULTS
RED
VERT YOKE DRIVE SIGNAL
BLUE
VERT OUTPUT TRANS
VERT YOKE
(OPTIONAL)
BLUE LEAD MAY BE CONNECTED TO CHASSIS GND INSTEAD OF LOW SIDE OF YOKE

Fig. 3—Set-up for injecting a vertical yoke drive signal.

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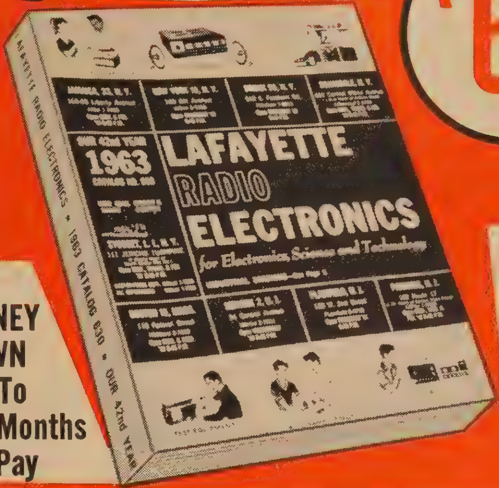

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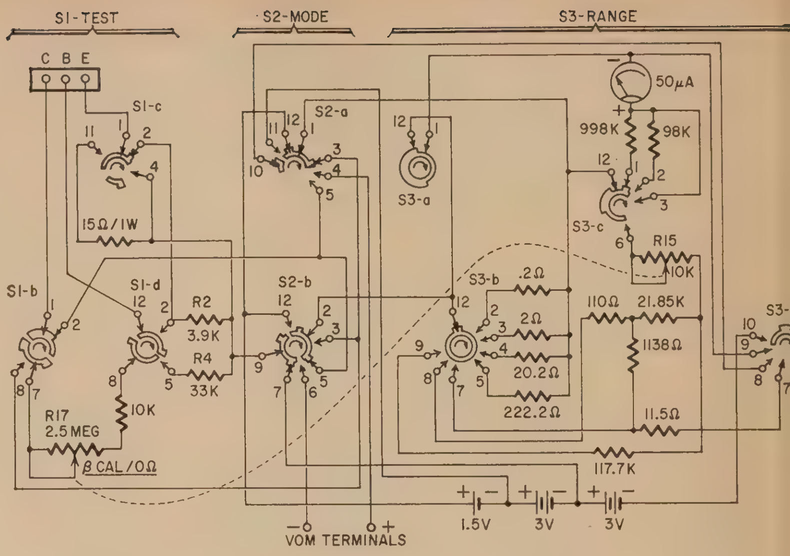

S1-TEST
S2-MODE
S3-RANGE
C B E
S1-c
S2-a
S3-a
50μA
998K
98K
S3-c
R15
10K
15Ω/1W
S1-b
S1-d
R2
3.9K
R4
33K
10K
R17
2.5 MEG
β CAL/0Ω
S2-b
S3-b
.2Ω
2Ω
20.2Ω
222.2Ω
110Ω
21.85K
1138Ω
11.5Ω
117.7K
1.5V
3V
3V
VOM TERMINALS

Complete circuit of the model 680.

to apply enough base voltage to give a collector current of 1 ma on the meter. Then the meter is switched to the base circuit to read base current. Since the collector-to-base current ratio is defined as dc beta, when collector current is 1 ma, dc beta is the reciprocal of the base current in ma and is read off a reciprocal current scale on the meter.

In the simulated ac beta test, base currents are read for two values of collector current. The difference between them is divided into the difference between the collector currents to give the ac beta.

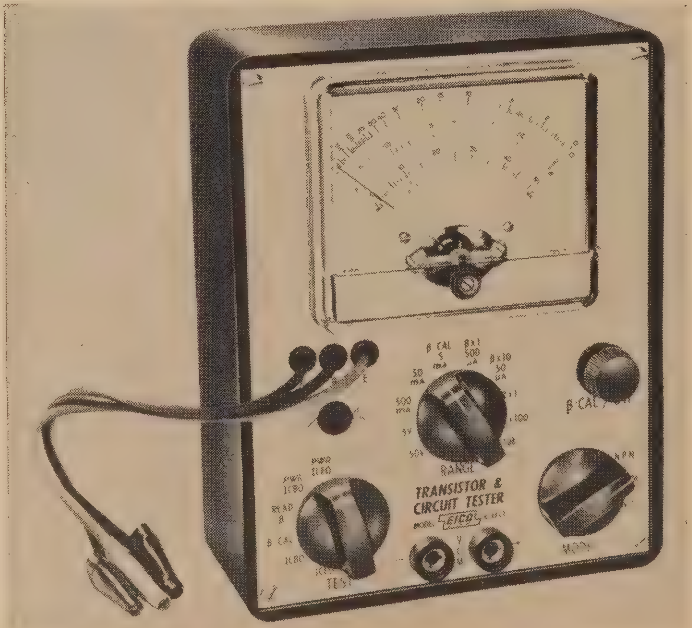
Diodes are checked by the ratio of the forward to the reverse current. Good selenium rectifiers should have a 10-to-1 ratio; germanium rectifiers, 100 to 1 ratio, and silicon diodes 500 to 1.

The voltmeter has two full-scale ranges, 50 and 5 volts. On the 50
range, 998,000 ohms is in series wit
meter; on the 5-volt range, 98,000 c
is in series with the meter.

There are also five current rang
50 μa, 500 μa, 5 ma, 50 ma and 500
The basic 50-μa meter is shunted
222.2 ohms for the 500-μa range;
ohms for the 5-ma range; 2 ohms fo
50-ma range and 0.2 ohm for the 500
range.

As with all vom's, resistance mea
ments can also be made. This meter
0 to 2,000-ohm; 0 to 200,000-ohm;
0 to 20-megohm scales.

Three clip-on test leads are
plied for hooking up power transi
and a front-panel socket for small-s
units. The 3½-inch meter makes it
to read the results of all measurem
off the meter dial.—*Larry Steckler*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WHAT'S YOUR EQ?

These are the answers
Puzzles are on page 59.

Four-Bulb Puzzler

Each black box contains a thermistor. The thermistors are not appreciably heated by the voltage drop across a lighted bulb. When a bulb burns out, the voltage drop across the thermistor is increased and its temperature increases. This brings its resistance to a value suitable for replacing the open bulb filament.

Simple circuit?

1. Reactance of two capacitors, each of 2 μf, in series, is 2,650 ohms. This value will not be affected by the presence of the diodes. The alternating current will be 38 ma, with or without the diodes.

2. 71 volts, with C positive with respect to A *or* B.

3. and **4.** One diode can be left out of the circuit without changing the statements under 1 and 2.

Ohms, sweet ohms

But wattage = E × I, and in the second situation both E and I are changed! The 10-volt battery that delivered 1 amp per cell is delivering 1.1 amp, or 11 watts, and the current from the 1-volt cell is also 1.1 instead of 0.1 amp, giving a wattage of 11 × 1.1. Total: 12.1 watts.

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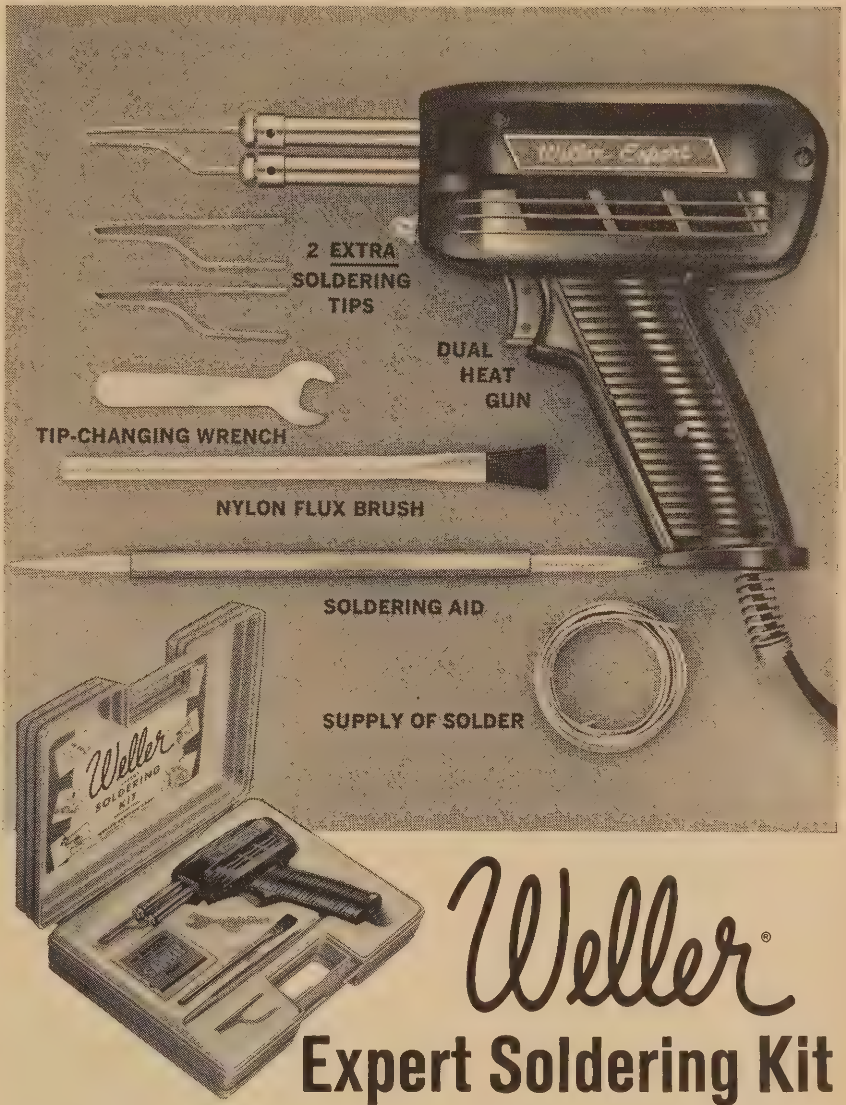

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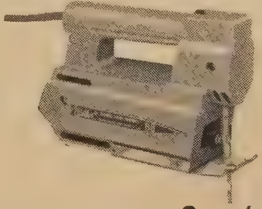

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Name____________________

Address____________________

He Does ☐ Does Not ☐ Stock Tarzian Tape

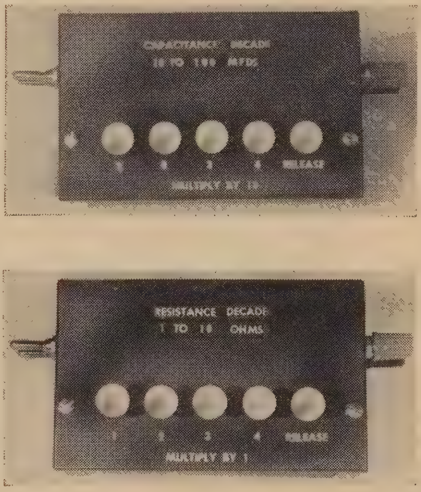
Pushbuttons add Ohms or Mf's

By JAMES A. FRED

Substitution box uses binary addition

COMPUTERS ARE BECOMING VERY POPULAR in the business world. Adding machines with pushbutton addition and subtraction are seen everywhere. We electronics hobbyists cannot afford computers or even adding machines, but by using a simple pushbutton switch we can add resistors in series or capacitors in parallel. Using only four resistors or capacitors, we can add them together to make 10 values. This circuit was published in *Electronic Equipment Engineering* magazine in their Circuit Design Award Program.

There are many types of resistor and capacitor decade boxes. The word decade is used to denote 10 units or, in the devices described here, from 0 to 10 units. Some decade boxes use a 10-position switch with 10 component values from 1 to 9. (The tenth position is zero, or transfer to the next decade.) Still other types use a special 10-position switch made by the P. R. Mallory Co. that, by an ingenious arrangement, adds four component values to produce 9 units. There are also less expensive boxes of resistors and capacitors called substitution boxes. They usually consist of a tap switch, with several positions, and several resistors and capacitor values to choose from.

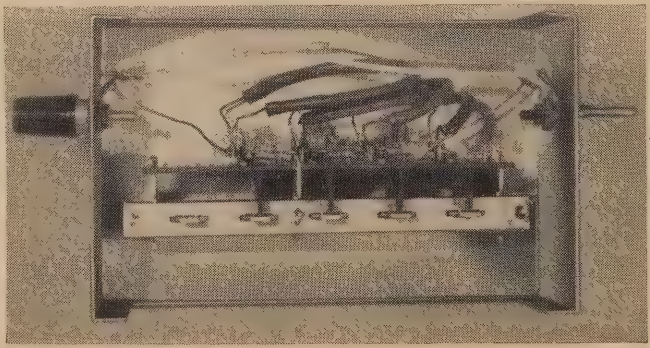


The two decade boxes are almost identical in appearance.

You will find these decade boxes (Figs. 1 and 2) useful, interesting and quite different from any you have seen before. They use 5-button pushbutton switches. Pushing down button 1 inserts one unit (either resistance or capacitance) into the circuit. Push buttons 2, 3 and 4, and you insert a like number of units into the circuit. To get additional units, combinations of these four buttons are pushed simultaneously. The values add, so pushing 3 and 4 inserts 7 into the circuit. The first four numbered buttons are self-latching while the fifth releases the first four when you wish to change the values you have previously selected. Another interesting feature is the mounting of two banana plugs on one end of the box and two banana jacks on the other end. This allows any number of decade boxes to be connected end to end to give almost any value needed by any experimental circuit.

[Unfortunately, the pushbutton switch specified (Mallory MCB 540) is comparatively expensive—$18.50 list—and it is made up only on special order. If you have no such switch on hand, try using four dpdt toggle switches instead. When you want to clear the unit, simply flip all the switches to the out-of-circuit position with one sweep of your hand. Or perhaps you have some other method that will also work. If so, drop us a card and tell us about it.—*Editor*]

If you do not intend to use this unit with others as a decade box, try



Inside view of the resistance box shows the use of Yard-ohm resistors.

setting up your values binary style—1, 2, 4, 8. This will give you coverage from 1 to 15 with the same number of components.

The switch and associated resistors or capacitors and the banana plugs and jacks are in a 5 x 3 x 2-inch box. The interior photo shows the resistors are made from length of Yard-ohm resistor, a product of P. R. Mallory & Co. A Yard-ohm resistor is made by winding a resistance around a fibrous glass core, crimping on terminals and slipping the whole resistor inside a piece of tubing. They are very handy to use whenever a low resistance is needed.

From the circuit diagram for the resistor decade box (Fig. 1) you can see that the resistors are all connected in series, with the normally closed contacts of the switch connected in parallel with each resistor. With no buttons pushed in, all the resistors are shorted out and there is no resistance in the circuit. As each button is pushed in, the resistor is unshorted and thus resistance is inserted into the circuit. Each individual resistor can be used by itself or, by pushing in more than one button, resistances will be added together.

The circuit for the capacitor decade box (Fig. 2) shows that each capacitor is connected in series with a normally open contact of the switch. These combinations are then wired in parallel. As each button is pushed in, the associated capacitor is introduced into the circuit. By pushing in more than one button at a time, the capacitors will add together in value. END

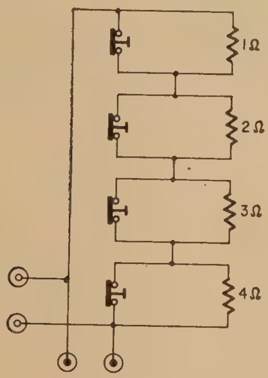


Fig. 1—Circuit of the resistance decade. Switches are normally closed.

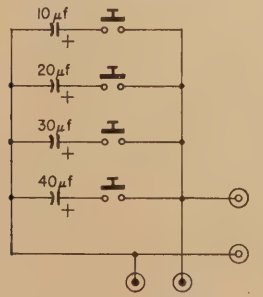
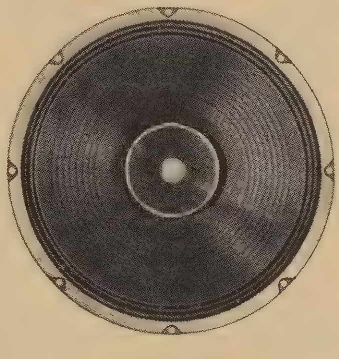


Fig. 2—Capacitance decade requires normally open switches.



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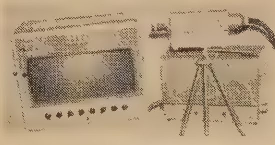

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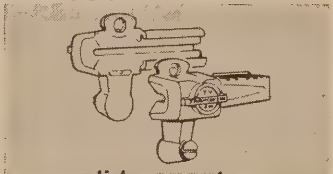
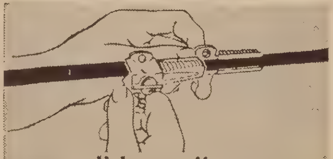
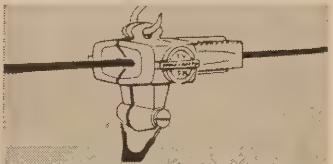

slide apart


slide on line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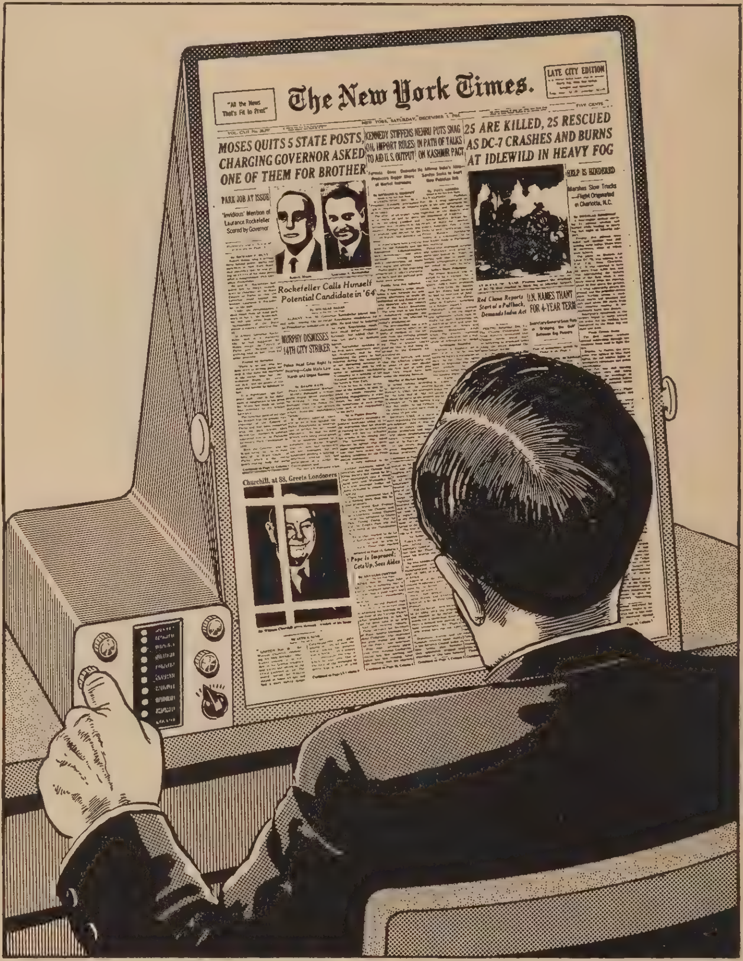
EDITORIAL

(Continued from page 31)

the naked eye a standard newspaper page reduced to 7½ x 5 inches. The reduced size, however, is necessary for speed in transmission.

When the newspaper is completely recorded, a special "end" signal is broadcast, stopping the recording. Now the motor rewinds the recording back to page 1. Then in the morning the reader merely presses a few buttons and page 1 of his newspaper, correctly enlarged, is projected through a lens-reflecting system on his home screen. Page 1 stays on till you press a second button which flashes on page 2 and so on. Another button brings back page 1 if desired.


"All the News That's Fit to Print"
The New York Times.
LATE CITY EDITION
MOSES QUITS 5 STATE POSTS, CHARGING GOVERNOR ASKED ONE OF THEM FOR BROTHER
25 ARE KILLED, 25 RESCUED AS DC-7 CRASHES AND BURNS AT IDLEWILD IN HEAVY FOG
Rockefeller Calls Himself Potential Candidate in '64
MURPHY DISMISSES 14TH CITY STRIKER
U.N. NAMES THANT FOR 4-YEAR TERM
Churchill, at 88, Greets Londoners

Instant Newspaper *of the near future. Entirely radio transmitted directly to the reader, ready before breakfast. View shows* Rafar *receiver with optically enlarged newspaper. It will be possible for the reader to have more than one newspaper at no extra charge except for the additional cost of roll paper.*

There is nothing visionary about this setup and no new breakthrough is needed. Practically all the facilities for Instant Newspaper *transmission and reception are in existence today. At first probably there would not be full newspaper transmission by* Rafar *exclusively. It would take several years before newspapers would transmit papers by radio 100%. In the interim, newspapers would still be sold on newsstands, but as new* Rafar *receivers are installed, fewer and fewer physical newspapers would be sold in this way.*

For compactness, the front of the rafarnews set is also the projection screen (see cut). It measures about 23½ x 16 inches to take the full size of a standard newspaper. You sit fronting the screen as if you were reading a regulation newspaper. *You can tilt the screen for the best reading position.*

Remember, you actually get a physical newspaper, printed on a roll that you can preserve. You can also take it with you on the train and by using a collapsible optical battery-fed enlarger, you can read your newspaper as usual.

The above is but the barest outline of the future rafar newspaper. It does not try to answer all questions. Here are a few:

1. Yes, readers can have more than one newspaper daily. The cost is the same, i.e., nil, except for more facsimile paper. The newspaper plants too must work out suitable noninterfering time schedules.

2. Servicing and replenishing paper or plastic rolls. A special servicing company (or companies) and service technicians will be necessary.

3. The greatest stumbling block: organized labor. The rafar methodology will inevitably throw many people out of work, and that may mean more eventual strikes.

We have had a rash of long and costly newspaper strikes all over the country for decades and many newspapers now operating are going more and faster into the red—or are closing down or combining with other papers to survive. Sooner or later the electronic newspaper MUST become an actuality—the speeded-up world demands it. It is better that the remaining newspapers operate profitably with greatly reduced staffs, than not at all.*

—*H.G.*

---

* See also "The Radio Set of 1950," by H. Gernsback, *Radio-Craft* magazine, February 1935.

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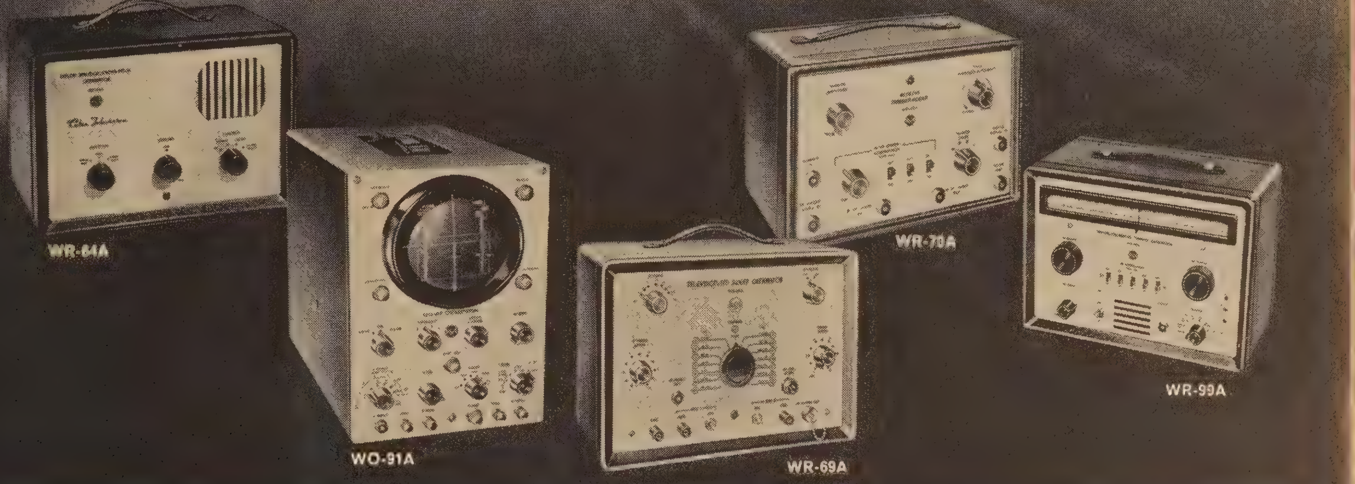

RCA Color-Bar/Dot/Crosshatch Generator

Low-cost, lightweight, portable instrument that provides all essential Color-TV test patterns. Simple to operate: only 3 controls. RF output leads connect directly to antenna terminals of receiver; no external sync leads required. Crystal-controlled signals assure rock-steady patterns, free from "jitter" and "crawl." Extra-wide-range chroma control. Generates:

- **Color-bar pattern**: ten bars of color, including R-Y, B-Y, G-Y, I and Q signals spaced at 30° phase intervals for checking phase and matrixing, and for automatic frequency and phase alignment. Permits accurate alignment of the "X" and "Z" demodulators which are used extensively in RCA Victor and many other makes of color TV receivers
- **Crosshatch pattern**: a grid-like pattern of thin sharp lines for adjusting vertical and horizontal linearity, raster size, and overscan
- **Dot pattern**: a pattern of small sized dots facilitating accurate color convergence adjustments

$189.50* with output cables.

RCA 5-Inch Oscilloscope for Color-TV

A wideband scope excellent for checking colorburst signals and general troubleshooting of wideband color circuits and other electronic equipment. Muilt-scale calibrated graph screen makes measurement of peak-to-peak voltage as easy as with a VTVM.

- New 2-stage sync separator assures stable horizontal sweep lock-in on composite TV signals
- Dual bandwidth: 4.5 Mc at 0.053 volt rms/in. sensitivity. 1.5 Mc at 0.018 volt rms/in. sensitivity
- Continuously adjustable sweep frequency range: 10 cps to 100 Kc
- 3-to-1 voltage-calibrated, frequency-compensated step attentuator for "V" amplifier
- Simplified, semi-automatic voltage calibration for simultaneous voltage measurement and wave-shape display
- Vertical-polarity reversal switch for "upright" or "inverted" trace display

$249.50*, including direct/low capacitance probe and cable, ground cable, and insulated clip.

RCA Television FM Sweep Generator

Specifically designed for visual alignment and troubleshooting of color and black-and-white TV receivers, and FM receivers. The RCA WR-69A has pre-set switch positions for all VHF TV channels, FM broadcast band, and TV video, chrominance, and IF frequencies. The WR-69A has these important features:

- IF/Video output frequency continuously tunable from 50 Kc to 50 Mc
- Sweep-frequency bandwidth continuously adjustable from 50 Kc to 20 Mc on IF/Video and FM; 12 Mc on TV channels
- Output level—0.1 volt or more
- Attenuation range:
  TV channels, 60 db
  IF/Video, 70 db
  FM, 60 db
- Return-trace blanking
- Two adjustable bias voltages on front panel

$295.00* including all necessary cables.

RCA RF/VF/IF Marker Adder

Designed for use with a marker generator (such as RCA's WR-99A) and a sweep generator (such as RCA's WR-69A), this instrument is used for RF, IF, and VF sweep alignment in both color and black-and-white TV receivers. In visual alignment techniques, it eliminates distortion of sweep response pattern. Important features:

- Choice of four different marker shapes provided by front panel switch for different types of sweep-response curves and for positive and negative sweep traces
- Provides very high-Q markers of high-amplitude and narrow bandwidth
- Complete front panel control of marker shape, marker amplitude, marker polarity, sweep amplitude, and sweep-trace polarity

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RCA Crystal-Calibrated Marker Generator

Supplies a fundamental frequency RF carrier of crystal accuracy for aligning and troubleshooting color and B&W TV receivers, FM receivers and other electronic equipment in the 19-260 Mc range. Combines functions of multiple-marker generator, rebroadcast transmitter, and heterodyne frequency meter.

- Highly stable output
- May be calibrated at 240 separate crystal check points—accurate calibration provided at 1-Mc and 10-Mc intervals
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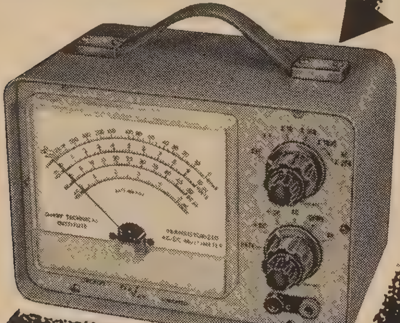

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- AC Voltage 0-5/0-50/0-500/0-1000
- Resistance 0-10 Megohms in 4 ranges
- Power 3-D cells and 1-C cell
- AC Frequency Response ± 1.5 db from 10 cps to 500 kcs
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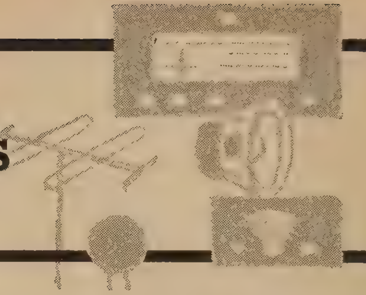
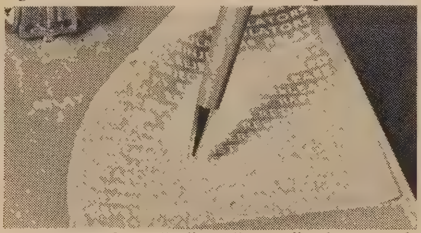
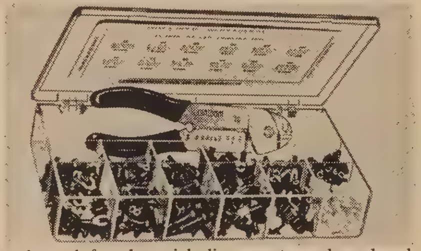


INSTANT LETTERING, *Letraset* method. For lettering electronic equipment. Requires no water, tape or screen. Presses on any glass, paper, wood, metal, plastic surface. Black or white printing. Set 24 sheets with hundreds of preset words and phrases from "ac" to "zooms", also sets alphabets, numbers.—**Datak Corp.,** 63 71 St., Guttenberg, N. J.

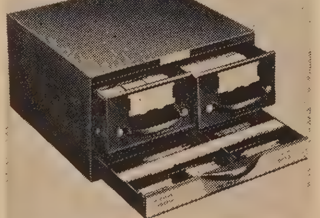


SOLDERLESS TERMINAL KITS with multipurpose maintenance tool. *Assortment K-120*: 620 noninsulated types. *Assortment K-130*: 330 noninsulated and 300 insulated. *Kit K-140*: 640 insulated. Terminal and connector types include ring tongue, flanged spade, spade tongue, butt connector, male and female quick-disconnects, nylon closed-end connector. Maintenance-crimping tool, *Type CT-4050*, handles wire sizes 22 through 10 AWG. Cuts and strips wires, crimps insulated and noninsulated terminals and connectors.—**Waldom Electronics,** 4625 W. 53 St., Chicago 32, Ill.

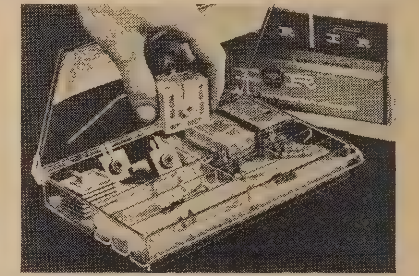


SOLDERING IRON, *Quik Shot.* Chemical cartridge heats iron to 850°F in 20 seconds. Maintains soldering temperature 7 minutes or longer. Thermit-mixture cartridge actuated in iron tip by handle trigger. 5 interchangeable tip sizes, ⅛ to 1 inch, pyramid and chisel.—**Kemode Manufacturing Co., Inc.,** 151 W. 18 St., New York 11, N. Y.

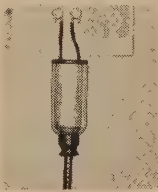
CONCENTRIC CONTROL KIT, *FRK-100.* 36 controls, 8 switches, 40 assorted shafts. Controls are part of manufacturer's Fastatch II system; plug-in, snap-on; housed in heavy-gauge steel cabinet. Shafts precut to exact lengths for installation. Cross-reference guide for quick selection of specific replacement.—**Centralab,** Div. Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.



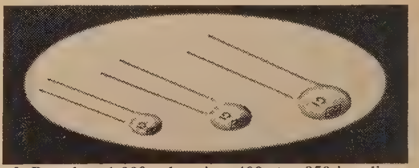
REPLACEMENT RECTIFIER ASSORTMENTS. 2 basic assortments contain selenium stacks, plug-in type silicon rectifiers, axial-lead types. *IR Caddy Kit*: 16 rectifiers of 10 most-used types with plastic divider box. *IR Rectifier and Diode Replacement Bench Cabinet* for in-shop use: 31 rectifiers and diodes in 16 most-used types, 4-drawer storage cabinet.—**International Rectifier Corp.,** 233 Kansas St., El Segundo, Calif.



BACK-OF-SET MATCHING TRANSFORMER, *model T-73.* Attach 75-ohm coaxial cable to 300-ohm TV set terminals. 2 inches long, balun type. 300-ohm terminal wires preattached to transformer circuit board. No special tools needed for connecting 75-ohm cable to transformer. Vinyl cable clamp with screw included. Transformer for use on 50–250 mc. Vswr 1.1:1, insertion loss ¼ db. —**Winegard Co.,** Burlington, Iowa.

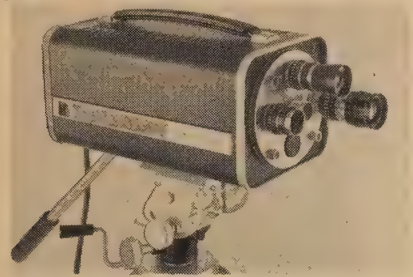


CERAMIC CAPACITORS, *CI Series Hi-Kaps.* For continuous operation at 220 vac rms 60 cycles as ac line bypass, will work under intermittent higher voltage. 6 standard values 470 to 10,000 pf. Rated at 1,000 vdc min. .400- to .850-in. diam., .180- to .240 in thick—**Centralab,** Div. Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

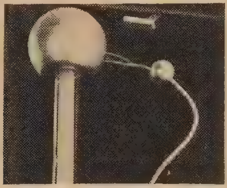


TV CAMERA KIT. For amateur TV, remote observation of hazardous operations, property protection, industrial use, education. Major parts preassembled on chassis. No printed circuit. Rf channels 2–6, 0.1-volt. Video, 1.5 volts peak to peak. Sync, random interlace (neg.) composite. Resolution 400 lines video, 300 lines rf. Vidicon tube and lens available separately.—**Craftsmen Instrument Labs, Inc.,** 60-30 34 Ave., Woodside 77, N. Y.

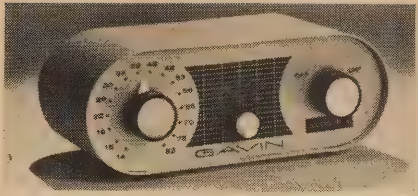
CLOSED-CIRCUIT TV CAMERA, *model VRF600.* Min. 600 lines video or 300 lines rf resolution. Automatic light compensation. 4-position lens turret uses standard C-mount lenses. 1 general-purpose lens, 4 aperture caps, 15-ft coax cable with video connectors, 15-ft coax cable with rf connectors, antenna impedance-matching transformer. Camera 12 x 7 x 6 in.—**Sylvania Electric Products, Inc.,** 730 3rd Ave., New York 17, N.Y.



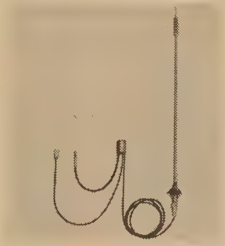
LIGHTNING-RESISTANT TV/FM BOOSTER, *model 0023, Telstar.* Antenna-mounted transistor booster resists 250,000 volts of lightning. See photo, where Van de Graaff generator arcs across to ball instead of to booster (above, to right of generator) at same distance from Van de Graaff. Feeds up to 4 TV and FM sets without isolation loss. Power supply located at set.—**Channel Master Corp.,** Ellenville, N. Y.



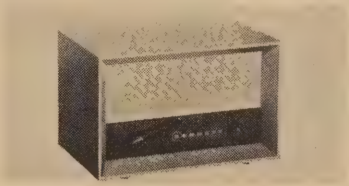
UHF CONVERTERS. *Model G-3,* 1 nuvistor, for good-signal, metropolitan areas to 45 miles from transmitter. *Model G-4,* 2 nuvistors, for fringe, low-signal areas. Vernier channel-selector knob, fine-tuning control on channel indicator. Built-in uhf–vhf coupler.—**Gavin Instruments, Inc.,** Depot Square, Somerville, N. J.



CB–AM ANTENNA, *model M-103.* Center-loaded cowl mount, fits into 7/8–13/16-inch hole. 46 in. high in operating position, telescopes to 31 in. Automatic dividing harness fits under dashboard. Equipped with 1-ft low-loss cable to AM set, 2-ft cable to CB rig, 5-ft cable to antenna. Harness accessory, M-104, fits any ungrounded CB antenna needing no more than 5-ft cable.—**Antenna Specialists Co.,** 12435 Euclid Ave., Cleveland, Ohio.



WIRELESS INTERCOM, *The Bennett.* Alnico V speaker/mike picks up normal conversation within 20 ft. 2-station unit usable with up to 8 ad-



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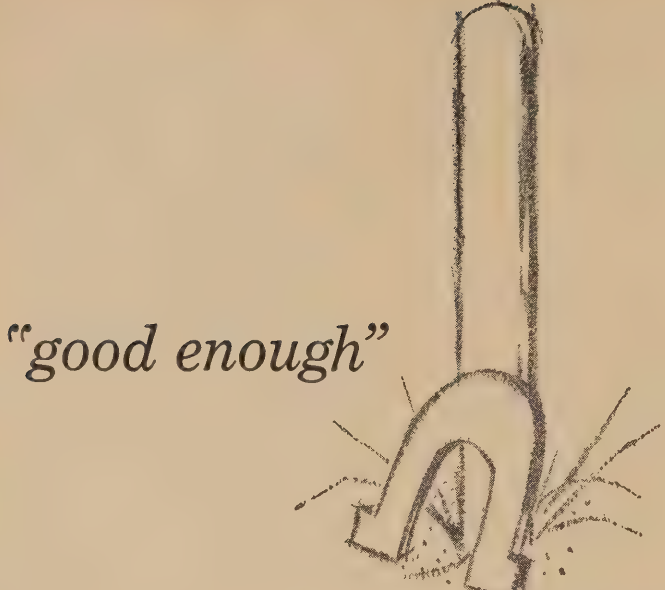

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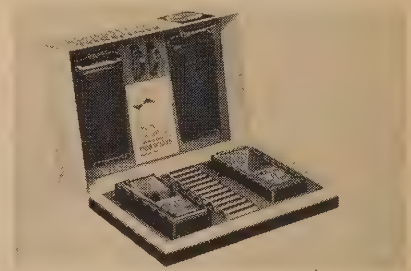

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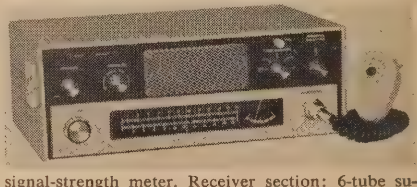

CB TRANSCEIVER, *model HE-90WX.* 2-way mobile or base station use. 5-watt crystal-controlled transmitter operates on any 6 of 23 channels with operating channel selected by front-panel control. Superhet receiver section: 6 crystal-controlled receive positions, tunable over all 23 channels. Nuvistor rf amplifier provides receiver sensitivity 1 μv. 3-stage i.f. circuit, adjustable squelch circuit, automatic volume control, electronic push-to-talk switch, automatic noise limiter. Transmitter pi-network output matches 30- to 100-ohm antenna and built-in TVI filter. Spotting switch for positive channel location, illuminated S-meter.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.

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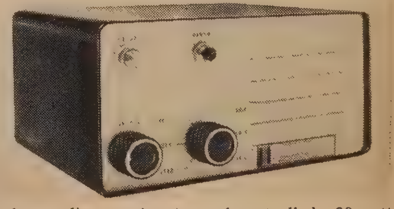

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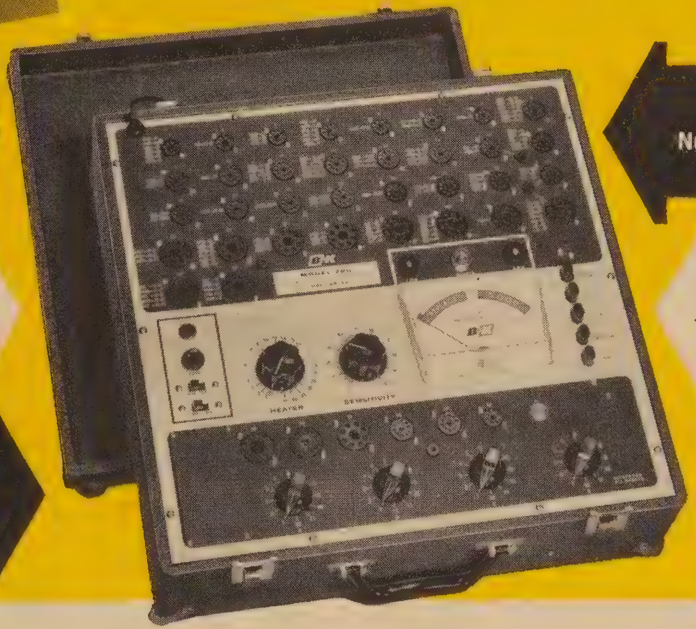

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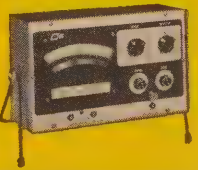

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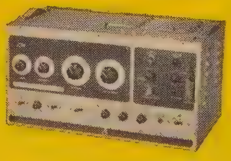

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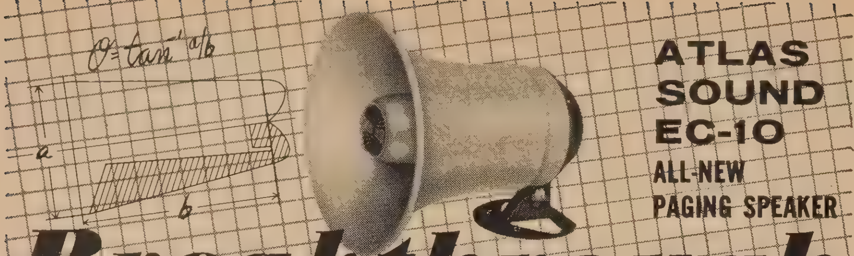

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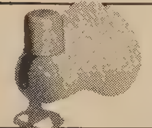

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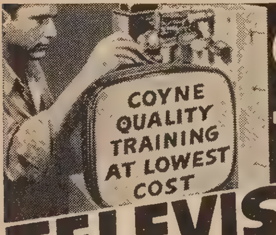
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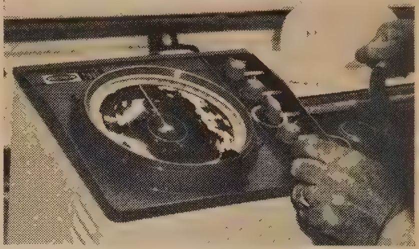

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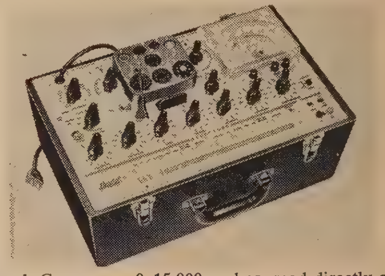
PORTABLE TUBE TESTER, *model 6000A.* For light industrial maintenance. Tests compactrons, novars, nuvistors, 10-pin types plus entertainment and some industrial tubes. Tube setup data on roll chart in panel. Replaceable socket panel. G_m ranges, 0–15,000 μmhos, read directly on meter. Interelement leakage, sensitivity 3 megohms, registered instantly on 5 neon lamps, identifying elements involved.—**Hickok Electrical Instrument Co.,** 10514 Dupont Ave., Cleveland 8, Ohio.



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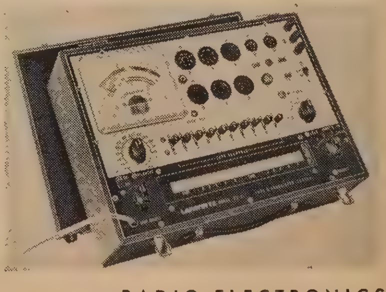

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____	3AV6	.42	____	6BK7	.85	____	6X4	.41	____	12EK6	.62
____	3BC5	.63	____	6BL7	1.09	____	6X8	.80	____	12EL6	.50
____	3BN6	.75	____	6BN6	.74	____	7A8	.68	____	12EZ6	.57
____	3BU8	.78	____	6BQ6	1.12	____	7AU7	.65	____	12F8	.66
____	3BY6	.58	____	6BQ7	1.00	____	7EY6	.75	____	12FA6	.79
____	3BZ6	.56	____	6BU8	.70	____	7Y4	.69	____	12FM6	.50
____	3CB6	.56	____	6BX7	1.11	____	8AU8	.90	____	12FR8	.97
____	3CS6	.58	____	6BZ6	.55	____	8AW8	.93	____	12FX8	.90
____	3DG4	.85	____	6BZ7	1.03	____	8BQ5	.60	____	12GC6	1.06
____	3DK6	.60	____	6C4	.45	____	8CG7	.63	____	12J8	.84
____	3DT6	.54	____	6CB6	.55	____	8CM7	.70	____	12K5	.75
____	3GK5	.99	____	6CD6	1.51	____	8CN7	.97	____	12L6	.73
____	3Q4	.63	____	6CG7	.61	____	8CS7	.74	____	12SF7	.69
____	3S4	.75	____	6CG8	.80	____	8EB8	.94	____	12SK7GT	.95
____	3V4	.63	____	6CL8	.79	____	8FQ7	.56	____	12SL7	.80
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____	4CS6	.61	____	6CN7	.70	____	11CY7	.75	____	12SQ7GT	.91
____	4DT6	.55	____	6CQ8	.92	____	12A4	.60	____	12U7	.62
____	4GM6	.60	____	6CR6	.60	____	12AB5	.60	____	12V6	.63
____	5AM8	.79	____	6CS6	.57	____	12AC6	.55	____	12W6	.71
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____	5BK7	.86	____	6CY5	.70	____	12AF3	.73	____	18FW6	.49
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____	5BR8	.83	____	6DA4	.68	____	12AJ6	.62	____	18FY6	.50
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____	5T8	.86	____	6DT5	.81	____	12AU7	.61	____	25C5	.53
____	5U4	.60	____	6DT6	.53	____	12AV6	.41	____	25CA5	.59
____	5U8	.84	____	6DT8	.94	____	12AV7	.82	____	25CD6	1.52
____	5V6	.56	____	6EA8	.79	____	12AX4	.67	____	25CU6	1.11
____	5X8	.82	____	6EB5	.73	____	12AX7	.63	____	25DN6	1.42
____	5Y3	.46	____	6EB8	.94	____	12AY7	1.44	____	25EH5	.55
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____	6AC7	.96	____	6EM7	.82	____	12B4	.68	____	25W4	.68
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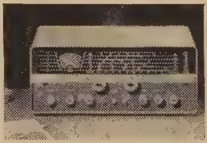

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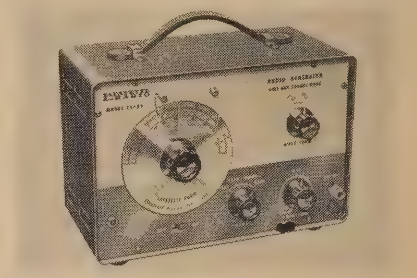
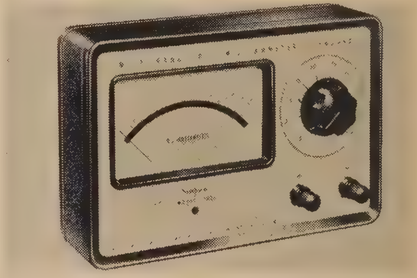
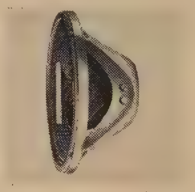


DC MILLIAMMETER, *model 1702.* Self-shielding, deep core construction with spring-mounted sapphire jewels, hardened-steel pivots. Temperature-compensated 15°C–35°C. Hand-stepped, hand-drawn, white-enameled dial with mirror segment. Tubular aluminum knife-edge pointer. Full-scale ranges: 1.5, 3, 7.5, 15, 30, 75, 150, 300, 750 and 1,500 ma. Accuracy 0.5% full scale in horizontal position at 25°C. Max. loss 50–150 mv. Dielectric test 3,000 volts rms. Magnetic damping. External zero adjuster.—**Simpson Electric Co.,** 5200 W. Kinzie St., Chicago 44, Ill.



12-IN. 3-WAY SPEAKER, *model KN-830.* 2 built-in crossovers, 13 oz ceramic magnet. Die-cast frame, Fiberglas coil form, long-throw coil design. Decoupled bass cone, compression type vhf driver, frequency level control. 5½ in. deep. 9¼ lb. Free-air resonance 60 cycles; frequency response 40–18,000 cycles; power capacity 20 watts music power. 2-in. voice coil, impedance 8 ohms.—**Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill.



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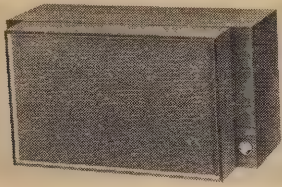
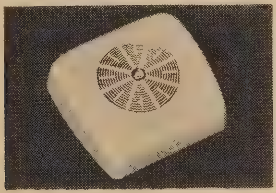
LOUDSPEAKER SYSTEMS, *model ADC-14, (illus.)* 25 x 13½ x 12½ in., response 38–20,000 cycles; *model ADC-16,* 27½ x 17 x 12½ in., 30–20,000 cycles; *model ADC-18,* 40 x 17 x 12½ in., 20–20,000 cycles. Rectangular woofer employs 9-lb ceramic magnet for high flux density and expanded plastic cone. Treble unit uses light 1½-in. Mylar diaphragm. Speaker stand *ADC-SS1* for models ADC-14 and ADC-16.—**Audio Dynamics Corp.,** Pickett District Rd., New Milford, Conn.



MULTI-PURPOSE BAFFLE, *model WD 5 DS, Little General.* For 5-inch speakers. Wall or desk mounting, in or outdoors, with or without 5-inch speaker. Accommodates small electronic circuits. Converts to intercom, amplifier–speaker combo, code practice set or remote speaker with volume control. High-impact, easy-drill Styron.—**Fourjay Industries,** 2801 Ontario Ave., Dayton 14, Ohio.



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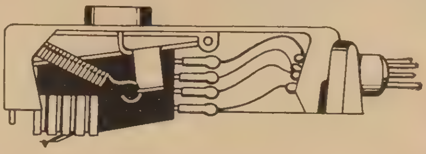
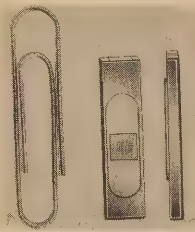


MINIATURE MICROPHONE, *model CA5A.* 1 x .250 x .100 inch, 0.75 gram. Lead zirconate element stable under temperatures 20°F to 200°F. Printed-circuit output connections. Frequency range 50–5,000 cycles, output level −73 db referred 1 v/microbar, open circuit. Impedance equivalent to 400 pf.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, Ill.



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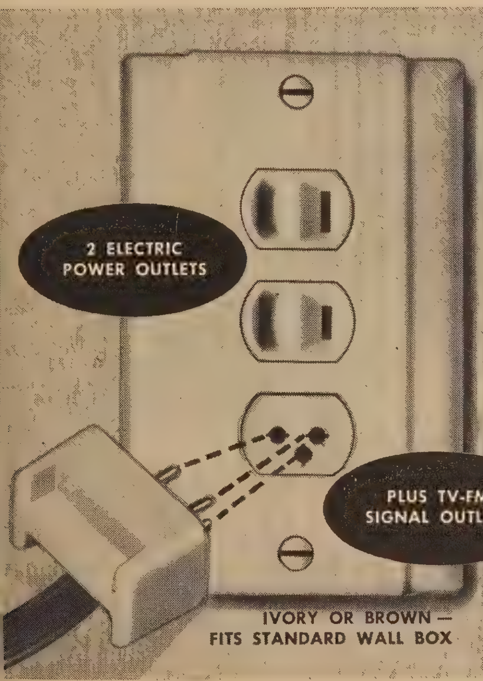
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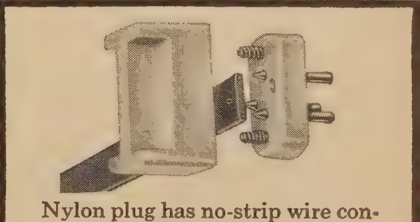

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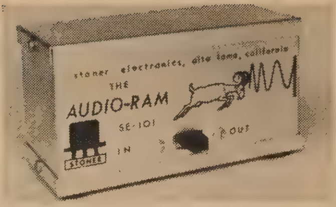

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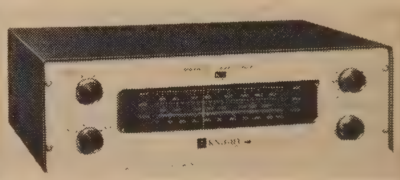

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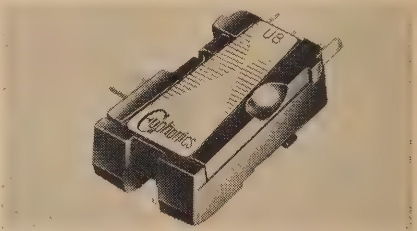

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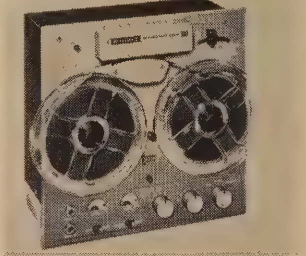
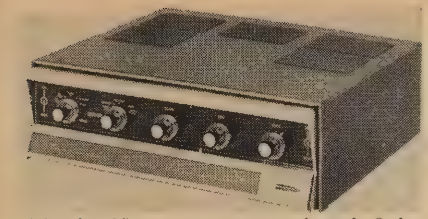
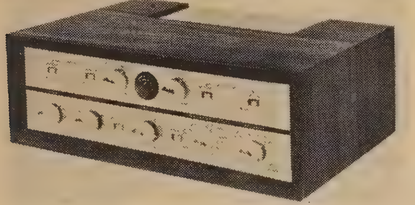


TRANSISTOR STEREO AMP, *model AAW-21.* Music power output 35 watts/8-ohm load. Response ± 1 db 13 cycles to 25 kc at rated output, ± 3 db 8 cycles to 40 kc rated output, harmonic distortion 1% at 20 cycles. IM distortion 1% at 60 and 6,000 cycles mixed 4:1. Hum and noise (below rated output): Tape head, 40 db; mag phono, 45 db; auxiliary inputs 60 db; tape monitor, 70 db. Channel separation 40 db min. at 20 kc. Input sen-



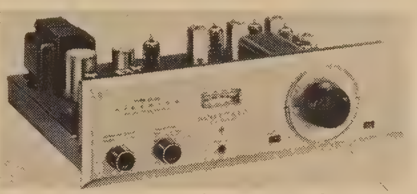
sitivity for 35 watts output per channel, 8-ohm load: tape head 2 mv; mag phono 3 mv; tuner 0.25 v; FM stereo 0.25 v; aux 0.25 v; tape monitor 0.90 v. Input impedance: tape head 60,000 ohms; mag phono 30,000 ohms; tuner 100,000 ohms; FM stereo 100,000 ohms; aux 100,000 ohms, tape monitor 47,000 ohms. Outputs: 4-, 8-, 16-ohm and low-impedance tape recorder outputs. 5-position dual concentric selector, 5-position mode switch. 28 transistors, 10 diodes. Power requirements 105–125 volts, 50-60 cycles ac. *Kit model AA-21.*—**Heath Co.**, Benton Harbor, Mich.

STEREO AMP/PREAMP, *model VC-50.* Electron-eye indicator balances left and right channels. Power output 50 watts, peak power 80 watts. Frequency response ± 1 db 30–30,000 cycles at rated output. Loudness compensation ± 15 db at low-level listening. Channel separation 45 db. Outputs: speakers 1 and 2: 4, 8, 16, 32 ohms; binaural, 600 ohms.—**Vidaire Electronics Manufacturing Corp.**, 365 Babylon Turnpike, Roosevelt, N. Y.



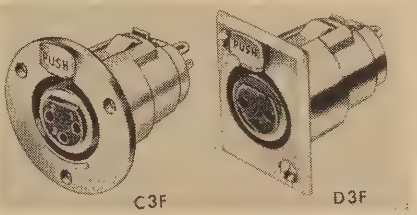
STEREO MULTIPLEX TUNER KIT, *model ST-55MX.* Dual limiters, Foster-Seeley discriminator, grounded-grid rf stage. Separation 30 db. Full-wave power supply, electrostatically shielded power transformer, 12 tubes including rectifier, EM84 tuning indicator. Tuning range 88–108 mc; sensitivity 2 μv for 30-db quieting. Harmonic distortion 1% from 20 cycles to 20 kc; bandwidth over 200 kc. 117 volts 50/60 cycles ac. Fully prealigned multiplex circuitry and complete FM circuitry on one printed-circuit board.—**Paco Electronics Co., Inc.**, 70-31 84th St., Glendale 27, N. Y.

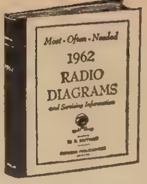
FM STEREO TUNER KIT, *LT-110.* Tuner in kit form includes manufacturer's *Sonic Monitor.* tonal stereo indicator. Parts mounted on part-charts in order used.—**H. H. Scott, Inc.**, Dept. P. 111 Powdermill Rd., Maynard, Mass.



Q-G AUDIO RECEPTACLES. 3-contact, female type for panel mounting. Ground circuit automatically completed when mating connector engaged. Circuit contact grounded to housing by

(Continued on page 90)





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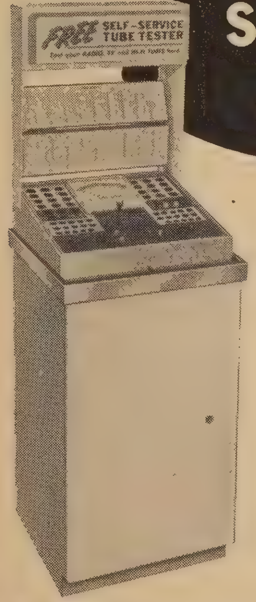
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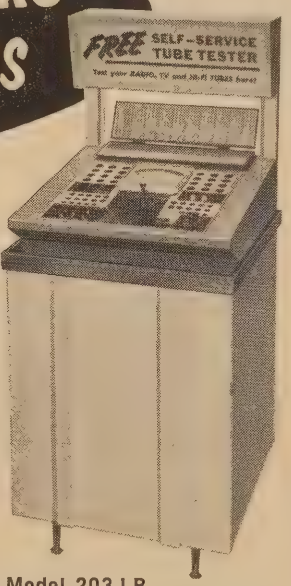
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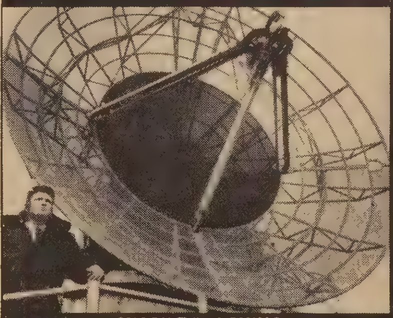
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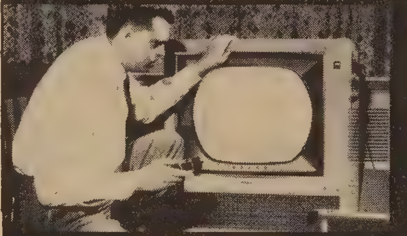
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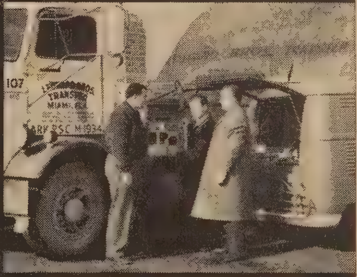
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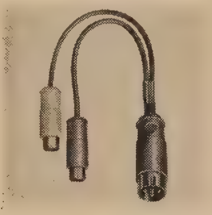
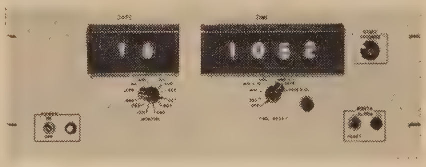
(Continued from page 85)

jumper wire between selected contact and ground terminal. *Part No. C3F*, round flanged type, mounts with 3 screws. *Part No. D3F*, rectangular, mounts with 2 scews.—**Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago 30, **Ill.**,

FLEXIBLE Y-ADAPTER, *Pat. No. 330H.* 3-pin Hirschmann type plug, connected to 2 color-coded phono jacks. Adapter plug inserts in input or output socket of Norelco, Grundig, Uher, Korting tape recorders. American-made recorder accessories plugged into phono jacks. No soldering, wiring or tools.—**Switchcraft, Inc.,** 5555 N. Elston Ave., Chicago 30, Ill.



DATE-TIME MONITOR. Solid-state modular device for telegraph communications and control systems. Time record of message transmission, reads out dates in month, day, 2400 hour "real time". Pulse-delay circuit inhibits minute count to change "on command" while data is being serialized from external parallel to serial converter. Power 105–125 vac at 50–60 cycles, 15 watts. Panel-mounted in standard 19-inch rack, 7 inches high. Operating temperature range 0°C to +50°C.—Communications Div., **Elgin National Watch Co.,** 366 Bluff City Blvd., Elgin, Ill.



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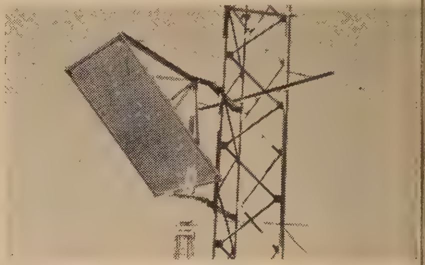
MICROWAVE REFLECTORS. Made of aluminum interlocking extrusions. 6 x 8, 8 x 12, 10 x 15 ft; 140, 280, 438 lbs. respectively. May be shipped knocked down for snap-together assembly.—**Rohn Manufacturing Co.,** Box 2000, Peoria, Ill. END



All specifications are from manufacturers' data

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TECHNICIANS' NEWS

TSADV Hits Service Plans

The Television Service Association of Delaware Valley is maintaining its opposition to manufacturers' factory service programs. Despite protests from service technicians and associations, ". . . we find ourselves in the midst of a mad whirl of price precedents—service and repair in the home for 90 days for $6, $4.95, $4.50 and $3.50 . . . repairs of portable televisions brought into the shop . . . are being rendered for as low as $2 . . ."

TSADV charges that these "ridiculous and fantastic" prices were concocted as sales gimmicks by "some white-collar officials, who probably never even see the inside of a set."

The association finds further cause for complaint in manufacturers' cost-cutting, resulting "in a product of questionable quality." As a result, TSADV says, "A method had to be devised to cover their mistakes and save their brand names." The outcome was the cut-rate service program, which, according to TSADV, is no solution, since the merchandise continues to be poor, and now the service technician is forced to provide adjustments at impossibly low rates.

The statement closes by saying, "These practices must be fought continuously and with determination if the independent service industry is to survive."

KCTSA Upgrades Seattle Service

Working closely with the Better Business Bureau, the King County Television Service Association, Inc. has worked to upgrade television service in the Seattle–King County area. According to James O. Humphrey, the association's public information director, there is a big job in public relations to be accomplished for the television service industry because of "scare" articles in national magazines.

By working with the Better Business Bureau, the King County Television Service Association has assisted in prosecuting cases where complaints were justified, and has also cleared up many misunderstandings which had resulted in unjustified complaints.

In a recent case, a TV technician in Seattle was charged with attempted petit larceny for having installed only one new tube rather than the three his

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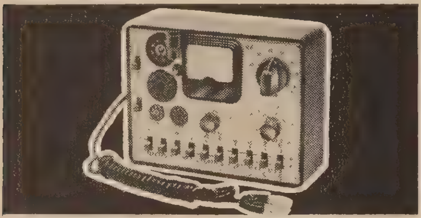

EMC Model — 211 Tube Tester — The smallest, lowest priced, domestic made tube tester on the market. It is completely flexible and obsolescent proof. It checks each section of multi-purpose tubes separately, checks all octal, loctal, 9 prong and miniature tubes for shorts, leakages, opens, intermittents as well as for quality. Quality is indicated directly on a two color meter dial using the standard emission test. Comes complete with instructions and tube charts in ring bound manual. Size 6¾″ x 5¼″ x 2¼″ deep. Shipping weight: 3 lbs.
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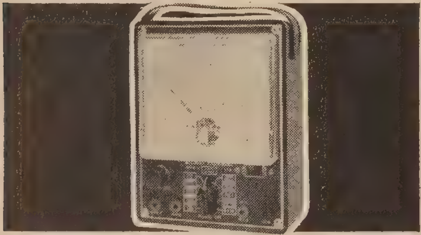

EMC Model 109 — Volometer— Features 20,000 OHMS volts DC sensitivity and 10,000 OHMS per volt AC sensitivity. Uses a 4½, 40 microampere meter, with 3 AC current ranges, and 3 resistance ranges to 20 megohms. 5 DC and AC voltage ranges to 3000 volts and 3 DC current ranges; also 5 DB range.
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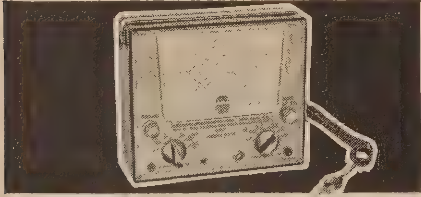

EMC Model 107A — Peak to Peak Vacuum Tube Volt-Ohm Capacity Meter — 6″ meter cannot burn out — entirely electronic. Measures peak to peak AC voltages to 2800 volts in 6 ranges. Measures capacity in 6 ranges from 50 mmfd to 5000 mfd. Measures resistance in 6 ranges from .2 ohm to 1000 megs. Measures DC volts to 1000 volts in 6 ranges. Input resistance to 16.5 megs. **Wired** .... $51.40 **Kit** $36.50

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employers tried to charge for. The customer took the $50 repair bill to the Better Business Bureau, which called in the King County Television Service Association for expert advice. On examining the set, James Humphrey found that two of the three "new" tubes were in fact tubes which had come with the set and were not readily available in the Seattle area.

Ensuing newspaper publicity had both a good and bad effect on public relations for the industry, according to Humphrey. It created suspicion against all repairmen, but it did help stress the importance of the customer's knowing his service man and dealing with reputable firms.

The King County association is also affiliated with the Washington State Electronics Council and the National Alliance of Television & Electronics Service Association. All three organizations encourage members to post a decal which will assure customers of reputable service.

In a written pledge to the BBB in Seattle, the King County Television Service Association has promised that if any of its members violate standards of practice or mistreat customers, the association will either refund the payment or repair the set. Through maintaining this pledge of ethics and through helping to prosecute unethical repairmen in the area, the association hopes to improve public relations for an industry which has been badly maligned in the past.

Northeast N.Y. TSA Elects

Albany, N.Y.—Roger Wells, of Guilderland, is the new TSA president for 1963. Other officers: vice president, Franze von Bank; secretary, Herbert Fitch, and treasurer, Mark Nadeau.

Election in Missouri

Columbia, Mo.—The 1963 president of TESA–Missouri is Gene Love. Others: Tom Ginnever, NE vice president; J. L. Windsor, SE veep; Jim Hatcher, NW veep; and Carl Adcock, SW veep. The new secretary is Benton Linder; treasurer, Charles Tilman. Board members: Bill Pryor, Don Ellis, Bill Frasure, Marion Crane and Howard Wiggs. W. R. Drennon is NATESA director, and Howard Wiggs is his alternate.

TESA-Milwaukee Meets

Milwaukee, Wis.—Highlight of the meeting was George Grabin's talk on the effective use of advertising in the TV service industry. He berated the industry for failing to promote its vital role in the manufacturer–broadcaster–viewer chain. The 21 members present also heard a letter to Jack Paar, protesting his derogatory remarks about

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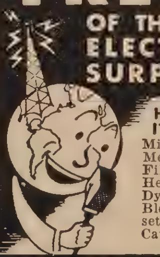

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TV servicetechnicians, made on a recent show.

Art Nelson reminded the association that 73% of small-business failures could be blamed on poor record keeping.

Gimmicked Set Jails TV Technician

Vele Kisvelvie, TV service technician of Calgary, Canada, was sentenced to 3 months in jail for fraud and operating without a city license. He charged a customer $7.97 for two tubes and a resistor that he had not replaced.

A group from the Electronic Retail Service Dealers Association blew a fuse in a TV set and marked all tubes with a dab of lipstick. A member took the set to Mr. Kisvelvie and requested that the repairs should not exceed $25.

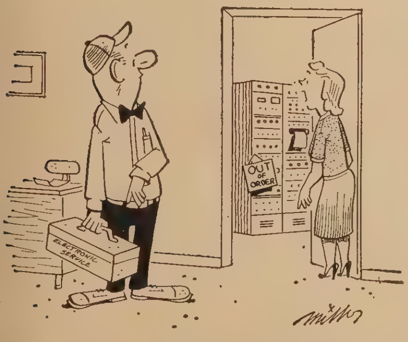
When the set was ready, the technician presented a bill for $21.57, listing $10 for labor and stating that three tubes and one resistor had been replaced. A check showed that the resistor and two of the tubes had not been replaced.

The magistrate said, "It may well have been a trap to catch the accused, and it may also have been part of a plan by big business men to put small operators out of business. But I do find that Kisvelvie did not replace three tubes and a resistor and there is no evidence to justify his actions."

California Has New 'Yellow Pages' Tariff

The California Public Utilities Commission has approved a tariff requiring all businesses involving "removal of appliances, furniture or other articles of value from the owners' premises" to list their business address along with phone numbers in any Yellow Page advertising.

This ruling was inspired by the California State Electronics Association (CSEA) in a public-spirited move to protect consumers from unscrupulous characters who take away TV sets for "service" in response to telephoned requests. If no address is given, the customer has little recourse if he gets poor service or perhaps never gets his set back at all. END



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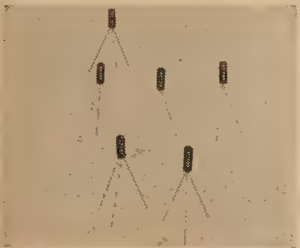

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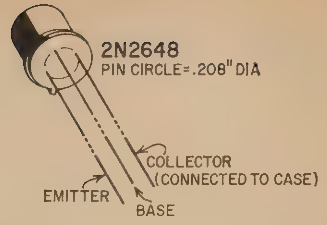


capable of dissipating 1.5 watts with a heat sink. Useful frequency range extends to 10 mc and beyond.

Maximum ratings:

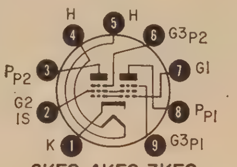
V_{CBO}	35
V_{CEO}	10
V_{EBO}	30
I_C	Limited only by dissipation

Switching characteristics:

t_r	0.3 μsec
t_s	0.9 μsec
t_f	0.5 μsec

6KF8, 4KF8, 3KF8

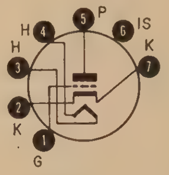
These tubes, which differ only in heater ratings, are 9-pin miniature twin-pentodes with separate plates and suppressor grids, but common screens, control grids and cathodes. They are intended for use as sync separator/clipper and agc generator. The common grid 1 can be used to suppress noise pulses from both sync and agc circuits. These can replace the 'BU8 and 'HS8 without changes. The 3KF8 and 4KF8, of course, have the usual controlled heater warmup time. Heaters are 3.15 volts at 600 ma and 4.2 volts at 450 ma, respectively. Raytheon is the manufacturer.



6KF8,4KF8,3KF8

6HA5/EC900 and 6GJ7/ECF801

Both these tubes use frame-grid construction for extremely high transconductance. The 6HA5 is a triode for vhf rf–amplifier use, and the 6GJ7, a triode-pentode, is meant for oscillator–mixer applications. It is the first mixer to use frame grids.



6HA5/EC900

The Amperex 6HA5 boasts a g_m of 20,000 μmhos, and their 6GJ7 a conversion transconductance of 5,000 μmhos, so that the two together in a

New BERNS Perfect Pin Crimper

Picture-Tube Repair Tool

Eliminates that hard soldering job

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Fix loose pin connections in seconds. Pays for itself in time saved on first job. 3" long.

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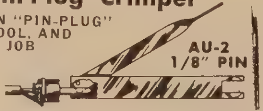
SLIP WIRE IN "PIN-PLUG" INSERT IN TOOL, AND SQUEEZE . . . JOB IS DONE.



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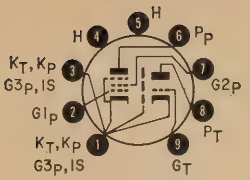


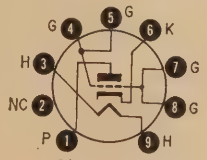
6GJ7/ECF801

front-end "package" can yield gain over 200. With only two high-gain i.f. stages, it is practical to produce a TV receiver with 5-μv sensitivity for 1 volt at the detector. Low noise, too.

CK5842WA

This low-noise frame-grid rf triode is intended to supersede the 417A and 5842. With its high transconductance and low interelectrode capacitances, this Raytheon tube is ideal for wide-band grounded-grid vhf applications.

Significant improvements claimed for this tube over previous types include tight control of heater current, plate current, transconductance and gain; reduced heater-to-cathode leakage (down to 7 μa maximum), an increase in altitude rating from 10,000 to 80,000 feet, much higher interelectrode insulation resistance, and greater shock resistance. END



CK5842-WA

New Abbreviations

RADIO-ELECTRONICS is adopting the modern abbreviation "pf" for "$\mu\mu$f". (The "p" in this case is short for pico, meaning "very small." Both the "p" and the "$\mu\mu$" represent 10^{-12}.) This abbreviation has been coming into more and more common use in the past year or two, and is especially handy for people who do not have the character "μ" on their typewriter keyboard.

We are also beginning to use "Q" instead of "V" to designate transistors. While usage has been split on this, "Q" is now used by the majority of American publications.

Since much material is already set up in type, readers will probably see both sets of abbreviations side by side in the magazine for a few months, but ultimately the newer ones will prevail.

Correction

Due to an unfortunate error, in the Brite Electronics advertisement on page 108 of the February issue, the price for the auto speaker kit is shown as $12.65. The *correct* price is $2.65.

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D.C. Amps	300Piv 210Rms	400Piv 280Rms	500Piv 350Rms	600Piv 420Rms
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12	1.65	1.90	2.70	3.69
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ELECTRONIC COMPONENT PRODUCTS listed in 6-page directory. Indexed by product, the guide gives direct sales locations by state and city. **—General Electric,** Schenectady 5, N. Y.

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DIODE REPLACEMENT GUIDE, *Form A-301,* for silicon rectifiers in automotive alternators. Multicolor guide lists by manufacturer's number and current rating all 30 original equipment automotive alternator diodes and exact replacements.**—Tung-Sol Electric Inc.,** 1 Summer Ave., Newark 4, N. J.

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CCTV BOOKLET, *"Closed Circuit Television Guide for Business and Industry."* 14-page, 3½ x 9-in. leaflet gives illustrations of actual installations now operating in plants and schools. Tells how CCTV can save money, perform hard tasks. Nontechnical description of CCTV, list of basic equipment, glossary of terms.**—Blonder-Tongue Labs, Inc.,** 9 Alling St., Newark 2, N. J. END

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

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Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In March, 1913, Modern Electrics

Measurement of Antenna Insulation and Earth Plate Resistance, by Stanley E. Hyde.

Wireless Station at the University of Michigan, by B. N. Burglund.

Oscillation Transformer Variometer Type, by Everett W. Davis.

A Radio High Frequency Buzzer, by Stanley E. Hyde.

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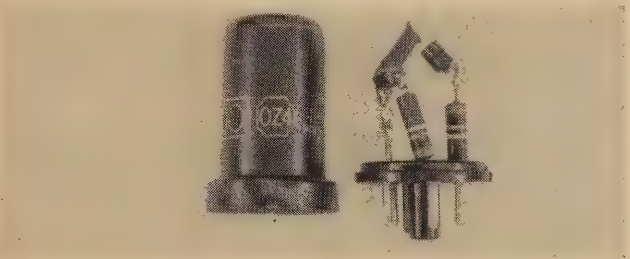
[Connecting a 220,000-ohm, ½-watt resistor across each rectifier helps prevent the trouble from recurring.—*Editor*]

OZ4 Replacement

It was Saturday afternoon, I had a big date set for the evening, I had just sold my last OZ4. I turn on my own car radio and it needs an OZ4. I call the distributor but he is closed for the day. What do I do now? I knew I had a pair of 1N2071 silicon rectifiers that would handle 750 ma at 600 volts piv. I connected the two positive terminals together and, using the base of the old OZ4, soldered it to pin 8. I then took two resistors, 10 ohms each, and soldered one to pin 3 and one to pin 5. Then I connected the other end of each resistor to a rectifier negative. I crimped the shell of the old OZ4 back on after I insulated all exposed wiring. I also reconnected the shell to pin 1 which is the ground. It worked better than the OZ4 and the set is definitely quieter between stations.—*Sid Elliot*



VM Tape Recorders

Watch out for these units. The shaft that carries the reel has a locking screw with a *left-hand* thread. Apparently every technician assumes this is a right-hand thread, from the large number of recorders we've seen in which this screw was stripped.—*Harry J. Miller*

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The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction, servicing, basic Hi-Fi and TV repairs, code, FCC amateur license requirements.

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The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The "Edu-Kit" has been used successfully by young and old in all parts of the world, by many Radio Schools and Clubs in this country and abroad. It is used for training and rehabilitation of Armed Forces Personnel and Veterans throughout the world.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. Every step is carefully explained. You cannot make a mistake.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore, you will construct radio circuits, perform jobs and conduct experiments to illustrate the principles which you learn.

You begin by examining the various radio parts included in the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set, you will enjoy listening to regular broadcast stations, learn theory, practice testing and troubleshooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are twenty Receiver, Transmitter, Code Oscillator, Signal Tracer, Signal Injector, Square Wave Generator and Amplifier circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

In order to provide a thorough, well-integrated and easily-learned radio course, the "Edu-Kit" includes practical work as well as theory; troubleshooting in addition to construction; training for all, whether your purpose in learning radio be for hobby, business or job; progressively-arranged material, ranging from simple circuits to well-advanced topics in Hi-Fi and TV. Your studies will be further aided by Quiz materials and our well-known FREE Consultation Service.

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You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hookup wire, solder, selenium rectifiers, volume controls, switches, knobs, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio & Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to the F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, and a High Fidelity Guide and Quiz Book. Everything is yours to keep.

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the assembled plug only after removing it from the outlet—an important safety feature. Mark each fused plug you use with the proper fuse value to insure correct replacement.

Two small holes at the rear of the plug expose a small end area of each fuse for voltmeter probes.

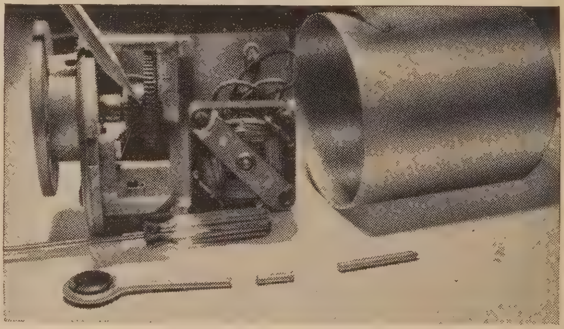
Placing the fuses at the wall outlet protects not only the equipment, but the long line cord as well.—*Robert K. Re*

Calibration Error in Tachometers

The practice of mounting a protective steel jacket over dc tachometer generators to protect them from accidental damage by fork-lift trucks, skids, etc. works well, but introduces an error in the tachometer generator output. The error is not large and can be corrected by moving the magnetic shunt adjustment on the generator. After such an adjustment has been made, the speed of the motor, belt or whatever must be checked with the shop standard hand tachometer to be certain that the indicator used with the tachometer generator is showing the true speed. A slight readjustment may be required.—*F. G. Lewis*

Emergency Rotor Pin

The wind had snapped the TV antenna and the rotor motor would run but the antenna would not turn. The Superrotor motor was removed by loosening two small bolts, turning slightly, and removing it from the motor assembly. A pin had sheared inside the gear assembly. For temporary operation, a section of a regular lead-in standoff was used as a cotter pin. Saw the standoff to the length of the sheared pin and drive the new pin into the gear assembly. The metal standoff is the same size as the sheared pin and works nicely as a temporary repair.—*Homer L. Davidson*



Watch Soldering Guns Around Meters

When building or working on equipment using a permanent-magnet moving-coil meter, don't use a soldering gun close to the meter or the gun will act as a demagnetizing tool, weakening the meter's permanent magnet, and throwing its calibration off.

To prevent meter damage, mount the meter last when building equipment and use a conventional soldering iron. Also, keep test equipment meters away from any soldering operations involving a soldering gun.—*George P. Oberto*

TRY THIS ONE

Precision Resistors

I often need relatively precise resistances which aren't cheap or easy to get. The cost of 1% resistors has forced me to cancel many of my pet ideas until I discovered a novel way of making my own custom units.

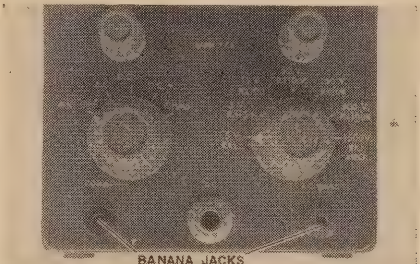
Merely select a stock 10% carbon resistor that measures slightly less on your ohmmeter than what is required for your circuit. With a small rat-tail or three-cornered file, start cutting through the center of the resistor body. In a matter of seconds you will have filed past the body and into the carbon resistance element. As you file, watch your ohmmeter reading, being sure to remove the file when observing the resistance value.

After a few file strokes, you will arrive at the value you desire within the accuracy of your meter. I normally do this with the resistor on a Wheatstone bridge but this sort of precision is not needed by most electronic experimenters. When you are through filing, cover the resistor "wound" with insulating tape or perhaps, better yet, a coating of all-purpose cement.

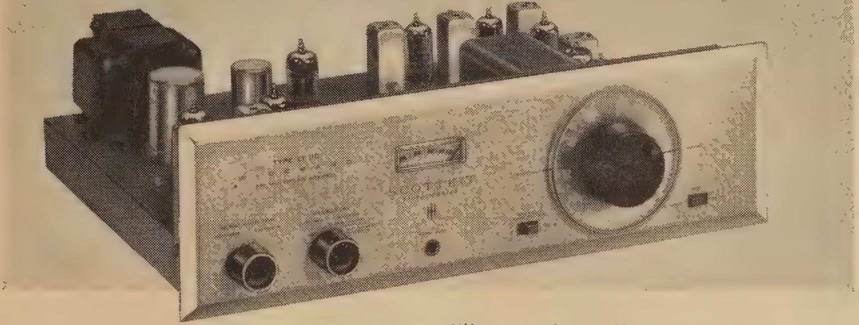
I find that this sort of "butchering" had negligible effect on the life or long-term stability of the resistor. However, the altered component should not be run too near its maximum rating because of the reduced size of the resistance element.—*G. R. Wisner*

Heath Vtvm Jacks

My Heath V-7A vtvm came equipped with banana type input jacks which employed a push-on spring-clip mounting. Continual pressure from inserting the test leads loosened the clips. Since the case must be removed before the clips can be tightened, it is just as


BANANA JACKS

SCOTT STEREO TUNER KIT WINS RAVE REVIEWS



"The LT-110 met all the manufacturer's detailed specifications on sensitivity, distortion, output level, a.c. hum, and capture ratio. . . . the audio response is excellent, being within ±1 db, from approximately 20 to 16,000 cycles. . . . Channel-to-channel crosstalk is particularly excellent both in terms of uniformity and the fact that it holds up."

Popular Electronics, Oct. 1962

"The LT-110 (is) so simple to build that we unhesitatingly recommend it for even the novice. . . . We found that the usable sensitivity (IHFM) was 2.1 μv. . . . a fine stereo tuner and an unusually easy kit to build."

Audio, April 1962

"It seems to me that every time I turn around I am building another of H. H. Scott's kits. And each time I end up praising the unit to the skies.

American Record Guide, Sept. 1962

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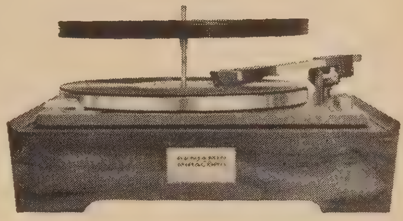

or automatically

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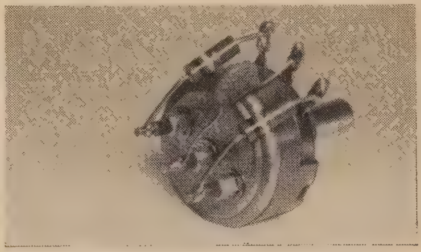
easy to replace the jacks with conventional threaded units. After removing the original jacks, dress the hole to 5/16-inch diameter. Insert regular threaded-body banana jacks, using insulated collar washers. Tests indicate no deterioration of input capacitance, and mechanical loosening is no longer a problem.—*William E. Bently*

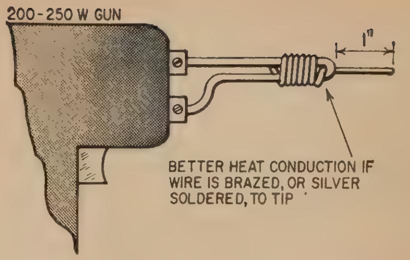
Mount Standoffs on Pot

By mounting a number of standoff terminals on the back of a pot, small parts to be wired to it are neatly arranged with minimum wiring. The holes can be drilled easily after prying off the cover on the back of the pot.—*Milton Lenheim Jr.*



Midget Tip for Soldering Gun

Coil a few turns of 3/32-inch copper wire tightly around a standard tip, leaving an extending piece about 1 inch long. Tin the end of the wire and run a little solder between the tip and the coil of wire. Change the tip for regular soldering. For better heat conduction, braze or silver-solder the wire to the tip.—*Wilbur Cressy*


200-250 W GUN
1"
BETTER HEAT CONDUCTION IF WIRE IS BRAZED, OR SILVER SOLDERED, TO TIP

Need a Needle Brush?

What phono or record changer doesn't need a needle brush? All phonos or changers that don't already have one! A nail-polish bottle or artist's brush plus a rubber suction cup makes a good inexpensive needle brush. If you use the artist's brush, cut off the handle near the ferrule so the bristles just touch the

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1X2
2A5
3CB6
3Q5
5U4
5V4
5Y3
5Z3
6A6
6A8
6AB4
6AC7
6AG5
6AL5
6AN8
6AQ5
6AS5
6AT6
6AT8

Type
6AU4
6AU5
6AU6
6AU8
6AV6
6AW8
6AX4
6BA6
6BC5
6BD6
6BG6
6BH6
6BJ6
6BL7
6BN4
6BN6
6BQ6
6BQ7
6BX7
6BZ6
6C4
6CB6
6CD6
6CF6

Type
6CG7
6CG8
6CM7
6CX8
6CZ5
6D6
6DA4
6DE6
6DQ6
6F6
6H6
6J5
6J6
6K6
6K7
6L6

Type
6Q7
6S4
6SA7
6SC7
6SH7
6SJ7
6SK7
6SL7
6SN7
6SQ7
6U8
6V6
6W4
6W6
6X4
6X5

Type
7A7
7B6
7B8
7C5
7Y4
12AD6
12AE6
12AF6
12AT7
12AU7
12AX4
12AX7
12B4
12BA6
12BD6
12BE6

Type
12BF6
12BH7
12BL6
12BQ6
12BY7
12C5
12CA5
12DQ6
12SN7
12SQ7
25L6
25Z6
35W4
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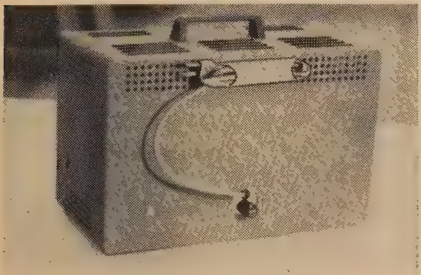
needle when the combination is attached to the turntable base just under the pickup arm. If the sticker doesn't stay stuck, wipe on a little glycerine or use rubber cement to attach it.—*Joe Crane*

Instrument Cord Holder

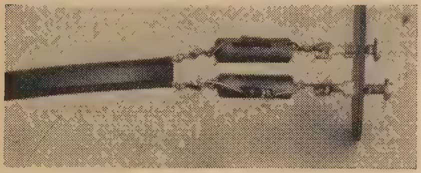
How do you wrap up the cord when you put an instrument on the shelf? The photo shows a simple solution to the dilemma. Pick up some aluminum tubing of the proper size, saw short sections at 45° angles, and mount them on the backs of your instruments, as illustrated.



This simple addition is a tremendous time-saver and a neat method of taking care of the ac cord. Larger tubing can be used for gear that has test cords and probes permanently attached.—*C. L. Barkdoll and R. E. Baird*

Hot-Chassis Protection

To prevent blowing fuses or worse, we isolate the hot chassis of an ac-dc set from the grounded antenna. At the shop end of the ribbon line from the shop antenna are suitable terminals. Just ahead of the terminals, in series with the antenna lead-in, are parallel connected resistors and capacitors. We use 100,000-ohm resistors and .001-μf 600-volt capacitors.—*Harry J. Miller*



Simple Socket Storage

Annoyed by having to dig all through your toolbox to find that one particular socket wrench you need? Why not string them all on a U-bolt as pictured and always have them together for quick, easy selection? This is a time and temper saver if there ever was one! —*Scott Mock* END

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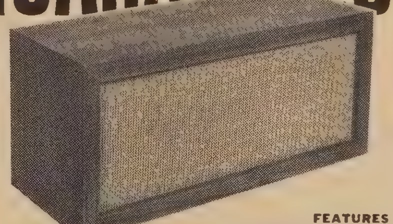

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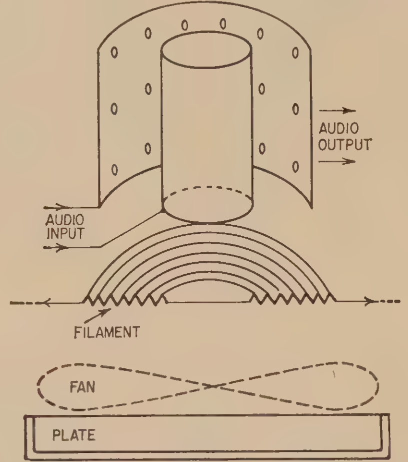
new PATENTS

Ionic Speaker

PATENT No. 3,022,385

Takis N. Panay, 1120 Vermont Ave. NW, Washington, D.C.

This speaker uses a cloud of ions (of air or other gas) to produce sound. It has a pair of cylindrical elements, perforated to pass sound. A hot wire or other ionization source discharges a cloud of negative ions which is driven upward by a fan.



A negatively charged plate repels the cloud and helps move it into the space between cylinders.

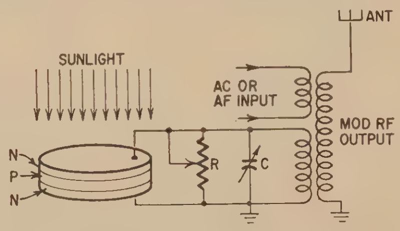
Audio power is impressed between cylinders. This ac makes the cloud vibrate, to generate sound. As an alternative, a grid may be inserted between cylinders. This grid is supplied with an audio voltage to control the mass of ions.

Self-Powered Transmitter

PATENT No. 3,050,684

Nathan Sclar, Glen Rock, N. J. (Assigned to Nuclear Corp. of America, Denville, N. J.)

This device generates dc, then converts it to rf. The inventor discloses that the junction requirements for a solar cell are similar to those for a tunnel diode. He includes two such junctions in a single unit.



Sunlight falling on the upper junction through the top surface generates approximately 0.3 volt. This is applied to the lower junction acting as a tunnel diode. The tank is tuned to a desired carrier frequency, while ac in a second winding modulates it.

R varies the load line for maximum output.

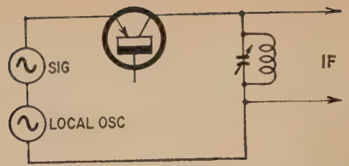
Low-Noise Mixer

PATENT No. 3,013,161

Olivier Garreta, Paris, France (Assigned to Compagnie Generale de Telegraphie Sans Fil, France)

This inventor has discovered that a transistor makes the best mixer at very high frequencies. The transistor should have a punch-through voltage of less than 15. This is the point after which current begins to rise abruptly. When the diode is supercooled, current does not flow until the voltage nears V$_p$. The resulting nonlinear curve makes an ideal mixer of voltages in the vicinity of V$_p$.

The mixer is connected as shown in the figure.



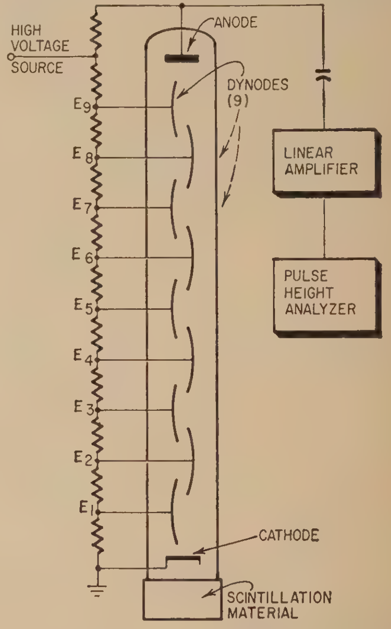
The signal and oscillator injection currents are fed into the emitter circuit. The transistor base is left open, and it is operated at —50°C. This circuit has very low distributed capacitance, low series resistance and introduces very little noise.

Stabilized Photomultiplier

PATENT No. 3,015,033

Nils L. Muench, Houston, Tex. (Assigned to Jersey Production Research Co., Tulsa Okla.)

A photomultiplier tube contains a cathode, several dynodes and an anode. Flashes of light from scintillating material cause electron emission from the cathode. As electrons move from one dynode to the next, their number is multiplied in each stage, due to secondary emission. When they finally reach the anode, a measuring device indicates the output, which is proportional to flashes per second.



Output from a dynode is very sensitive to changes in voltage. Normally, E$_1$ is 300 volts, while the other dynodes are biased to 150 volts. This inventor suggests raising E$_9$ to 1,000 volts. In this saturation region, gain is high and independent of voltage. All other dynode voltages except E$_1$ are cut to 30 volts. At this value, gain is low but again independent of voltage.

The result is that the total gain of the tube, as well as the applied voltage, remain unchanged. The stability of each stage is greatly enhanced. END

"No, ma'am, there just ain't anything left to brighten."

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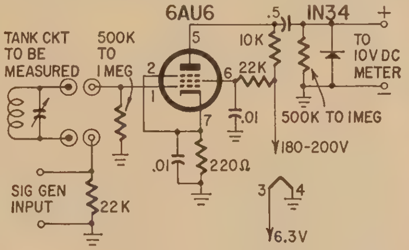
NOTEWORTHY CIRCUITS

Resonance Indicator

Here is a simple resonance indicator that you can build and use with the shop's signal generator and vom as a substitute for a grid-dip oscillator in many applications. It is handy to have on the bench when checking a loop or ferrite-rod antenna, for finding the tuning range of an L-C circuit and when tuning BCI traps. The power supply can be built in or the indicator can be powered by the bench supply.

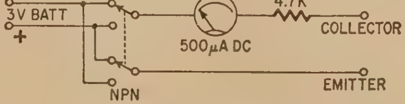
The loop antenna or tank circuit to be checked is connected in the 6AU6's grid circuit in series with a 22,000-ohm resistor, the other end of which is grounded. The signal generator output is applied across the resistor. A vom or vtvm indicates the relative strength of the amplified signal. I use the 10-volt range of a volt-ohmmeter.



When checking an unknown L-C network, tune the generator for a maximum reading on the meter. The signal generator's tuning dial shows the resonant frequency of the L-C circuit. To set up a loop or ferrite antenna, connect the antenna and tuning capacitor to the indicator. Close the tuning capacitor and tune the signal generator for a peak between 500 and 600 kc. The circuit should peak at 550 kc. Add or remove turns as needed.—*Robert E. Flanagan*

Transistor Type Identifier

Technicians and experimenters may need a method of determining whether an unknown transistor is a p-n-p or n-p-n type. The diagram shows how a 3-volt battery, 500-μa meter and a dpdt switch can be used for this pur-



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18 THINGS YOU MUST KNOW TO SERVICE MARINE ELECTRONIC EQUIPMENT SUCCESSFULLY

HOW TO INSTALL & REPAIR MARINE ELECTRONIC EQUIPMENT by Elbert Robberson

Repair and maintenance of marine electronic equipment differs from servicing all other types of electronic gear. Its installation and repair cannot safely be undertaken without certain knowledge. This book provides anyone with a basic foundation in radio with the special knowledge required to service marine electronic gear. What's more, the technically minded boat-owner can acquire the know-how to keep his electronic equipment in top operating condition. Here are 18 points, essential to servicing marine equipment properly, made absolutely clear and understandable in this book. **1.** Technical and license requirements for technicians. **2.** The instruments and tools — how they are used, FCC regulations and standards. **3.** The electrical systems of boats — requirements for connecting electronic equipment to attain maximum efficiency and prevent possible damage. **4.** Radiotelephone circuits including: receiver, transmitter, modulator and power supply, transistorized portions. **5.** Powerboat antenna and ground problems, their solutions. Mechanical and electrical requirements for their installation and service. **6.** Installation of efficient antennas on sailboats — rigging procedure. **7.** Practical tips of radiotelephone installation — power, antenna and ground wiring, troubleshooting. **8.** Preliminary and on-the-job tuning of the radiotelephone transmitter, receiver and antenna circuits. **9.** Radio direction finders from portable transistorized band operated units to automatic direction finders — their circuitry. **10.** Installating and calibrating radio direction finders. **11.** Echo sounders — principles and construction — how to install the equipment and transducers; testing, maintenance. **12.** Automatic steering devices (pilots) — electronic and electrical. **13.** Small-craft radars — theory and construction with data on special components (magnetrons and klystrons); installation. **14.** Loran receivers — theory, elements, installation. **15.** Electrical interference-sources, and how to reduce or eliminate them. **16.** Electrolysis or galvanic corrosion — how to prevent it. **17.** Protecting equipment, the boat, the personnel from lightning. **18.** Console and Consolan navigation receivers — their characteristics. #230, Soft cover **$4.50,** #230-H, cloth **$5.95**

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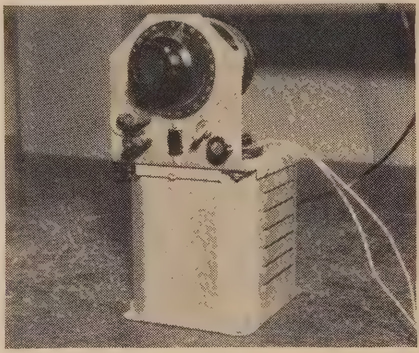
pose. When the output leads are connected to the transistor's collector and emitter as indicated, the meter reading is considerably higher in one position. The switch position giving the higher meter reading indicates the transistor type. The resistor protects the meter if the transistor is shorted.

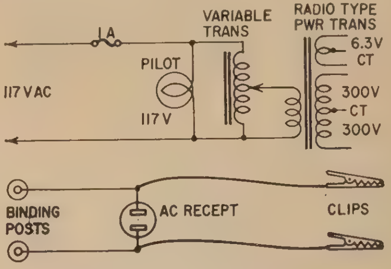
The meter reading also provides useful information on the leakage current of the transistor being tested. The lower the maximum reading, the better the transistor's I_{CEO}.—*R. G. Dancy*

A Variable Ac Voltage Supply

We constructed the unit shown in the photo and diagram to provide a source of isolated ac. It uses a standard 1-ampere Variac mounted on a piece of 6 x 8 x 1/16-inch aluminum. This assembly is in turn fastened to the upper mounting holes of a UTC power transformer.



The primary lead wire is fused by a 1-amp fuse in a holder located in the lower right-hand corner of the mounting. A toggle power switch is directly above it. The pilot light is on the left.



The output connectors are universal type binding posts. They are connected to two 8-inch flexible leads which can be soldered or clipped to the 6.3-volt or the high-voltage winding of the transformer. They may also be connected to the Variac output to give adjustable voltage from zero to 115–140 volts (depending on model and type of variable transformer) without isolation.

This arrangement is not limited to the UTC transformer shown as any similar transformer may also be used. The weight of the transformer helps keep the supply in position on the bench and makes it possible to adjust the Variac without using two hands.

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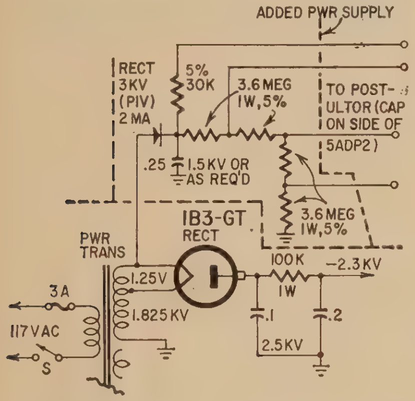
50–60-cycle power frequencies but it can be used for short periods on 400 cycles. In addition to its use as an ac power source, the combination may also be used as a power transformer for substitution checks on power supplies or as an adjustable audio transformer for rough impedance checks.—*Fred J. Lingel, K1CCW*

More Brightness for Your Scope

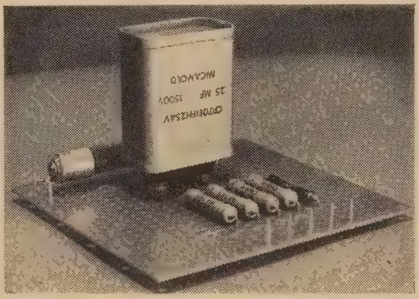
Several recent oscilloscope kits use a 5ADP2 cathode-ray tube with the post-deflection accelerator electrode connected to the B-plus line at around 400 volts. By adding a few components,



you can increase the post-deflection accelerator (post-ultor) voltage. This will sharpen and brighten the trace without reducing deflection sensitivity.

The diagram shows the high-voltage power supply of the Heathkit OP-1. A semiconductor rectifier, filter and voltage divider have been added to supply a higher positive voltage to the post-ultor electrode. Connect this electrode to the tap best suited for your CRT.

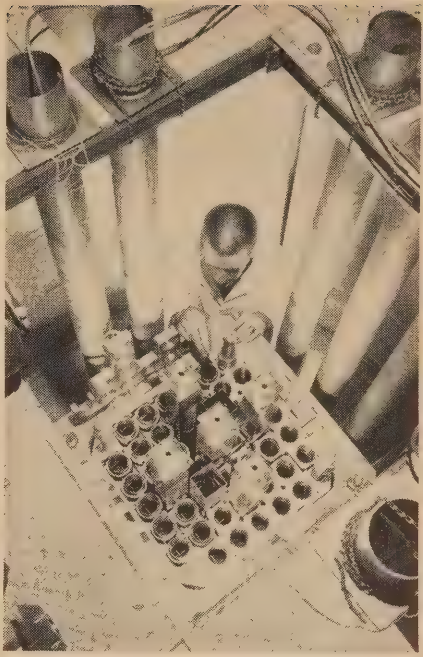
The photo shows the auxiliary power supply on its perforated board.



The board makes a solid base for the unit and is a good insulator for the 2,500 volts (rms) that some scopes develop.—*B. C. Terell*

[When the voltages from the new power supply are applied to the scope, the deflection may fall short of full screen for both the horizontal and vertical amplifiers.

The semiconductor rectifier may be a selenium high-voltage cartridge type like the International Rectifier V75HF.—*Editor*] END



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A manual for the tape recorder owner that will show him the best ways to use his equipment.

CB RADIO MOBILE HANDBOOK, by Jim Kyle. *Horizons Publications Inc., 4 N. W. 7th St., Oklahoma City 1, Okla. 5½ x 8½ in. 133 pp. Paper, $2.95.*

Well written little book, directed mainly at the nontechnical CBer interested in maintaining and improving his equipment. Contains list of regional calling channels.

101 MORE WAYS TO USE YOUR VOM AND VTVM, by Robert G. Middleton. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in., paper. 128 pp. $2.50.*

Use your meters to check appliances, lamps, motors, transformers and special circuits.

FUNDAMENTALS OF SEMICONDUCTOR AND TUBE ELECTRONICS, by Alex Romanowitz. *John Wiley & Sons Inc., 440 Park Ave. So., New York 16, N. Y. 6 x 9 in. 620 pp. Cloth, $8.25.*

A comprehensive text that is a top-quality first course in electronic tube and semiconductor theory and circuitry.

THE LP/STEREO RECORD GUIDE AND TAPE REVIEW, by Warren DeMotte. *Argyle Publishing Corp., 298 5th Ave., New York 1, N. Y. 5½ x 8 in. 320 pp. Paper, 95¢.*

Aimed at the collector, this book con-

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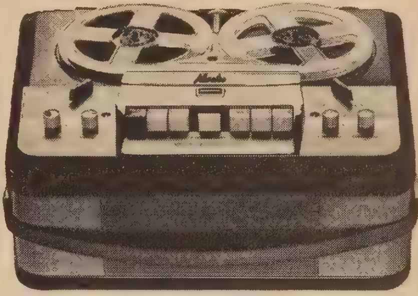

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COMMUNICATIONS DICTIONARY, by James F. Holmes. *John F. Rider Publisher, Inc., 116 W. 14 St., New York, N. Y. 6 x 9 in. 96 pp. Paper, $1.50.*

A compilation of terms used in the fields of electronic communications and data processing.

SIMPLIFIED THEORY AND APPLICATION OF DELAY LINES, by JFD Electronics Corp. staff. *JFD Electronics Corp., Components Div., 6101 16th Ave., Brooklyn 4, N. Y. 8½ x 11 in. 51 pp. Paper, $2.00, requested on company letterhead.*

A complete treatise of theory and practice, ending with an eight-page "questionnaire" which demonstrates the specifications needed to design or order delay lines.

BRITISH MINIATURE AND SUBMINIATURE VALVES DATA ANNUAL, 1962–63, edited by G. W. A. Dummer and J. Mackenzie Robertson. *Pergamon Press, Inc., 122 E. 55 St., New York 22, N. Y. 8½ x 11 in. 921 pp. Cloth, $30.*

Complete specs on all British tubes in these two classes, including cold-cathode tubes, voltage stabilizers, reference tubes, tuning indicators, trigger tubes and thyratrons. An "equivalents" list (52 pages) cross-references the tubes of each manufacturer with those of similar electrical characteristics, whether miniature or otherwise.

MUSIC, ACOUSTICS & ARCHITECTURE, by Leo L. Beranek. *John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N. Y. 7½ x 11 in. 586 pp. Cloth, $17.50.*

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TELEVISION ENGINEERING (Vol. 4), by S. W. Amos and D. C. Birkinshaw. *Iliffe Books, Ltd., Dorset House. Stamford St., London, SE1, England. 5 x 7¼ in., 277 pp. 35 shillings net.*

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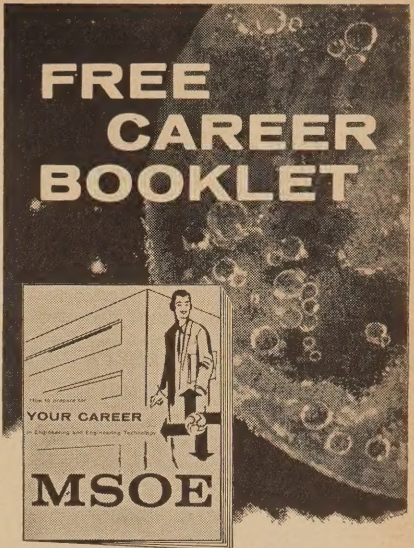

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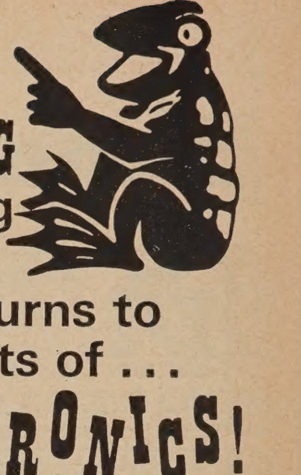

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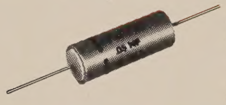
Capacitor success stories are no novelty at Sprague. The "Hidden 600", Sprague's behind-the-scenes staff of 600 experienced researchers, have authored scores of them! And customers add new chapters every day. But none has proved more popular than the 6 best sellers shown here. Developed by the largest research organization in the capacitor industry, these 6 assure happy endings to service technicians' problems.

❶ DIFILM® BLACK BEAUTY® MOLDED TUBULAR CAPACITORS

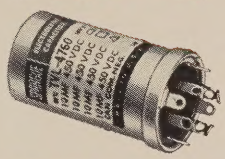


The world's most humidity-resistant molded capacitors. Dual dielectric—polyester film and special capacitor tissue—combines best features of both. Exclusive HCX® solid impregnant produces rock-hard section—nothing to leak. Tough case of non-flammable phenolic—cannot be damaged in handling.

❷ DIFILM® ORANGE DROP® DIPPED TUBULAR CAPACITORS

Especially made for exact, original replacement of radial-lead tubulars. Dual dielectric combines the best features of both polyester film and special capacitor tissue. Exclusive HCX® solid impregnant—no oil to leak, no wax to drip. Double dipped in bright orange epoxy resin to beat heat and humidity.

❸ TWIST-LOK® ELECTROLYTIC CAPACITORS



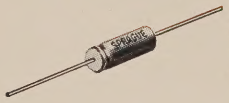
The most dependable capacitors of their type. Built to "take it" under torrid 185°F (85°C) temperatures—in crowded TV chassis, sizzling auto radios, portable and ac-dc table radios, radio-phono combinations, etc. Hermetically sealed in aluminum cases for exceptionally long life. Withstand high surge voltages. Ideal for high ripple selenium rectifier circuits.

❹ ATOM® ELECTROLYTIC CAPACITORS

+ SPRAGUE
"ATOMS"
TVA1414

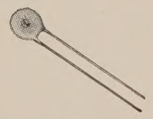
The smallest dependable electrolytics designed for 85°C operation in voltages to 450 WVDC. Small enough to fit anywhere, work anywhere. Low leakage and long shelf life. Will withstand high temperatures, high ripple currents, high surge voltages. Metal case construction with Kraft insulating sleeve.

❺ LITTL-LYTIC® ELECTROLYTIC CAPACITORS



Ultra-tiny size for use in transistorized equipment. High degree of reliability at reasonable price. All-welded construction—no pressure joints to cause "open" circuits. Withstand temperatures to 85°C (185°F). Hermetically sealed. Extremely low leakage current. Designed for long shelf life—particularly important in sets used only part of the year.

❻ CERA-MITE® CERAMIC CAPACITORS



Tiny, tough, dependable in practically every application. Low self-inductance of silvered flat-plate design gives improved by-pass action in TV r-f circuits. Higher self-resonant frequency than tubular ceramics or micas. Tough moisture-proof coating. Designed for 85°C operation.

* *The "Hidden 600" are Sprague's 600 experienced researchers who staff the largest research organization in the electronic component industry and who back up the efforts of some 8,500 Sprague employees in 16 plants strategically located throughout the United States.*

Handy Hanging Wall Catalog C-457 gives complete service part listings. Ask your Sprague Distributor for a copy, or write Sprague Products Company, 81 Marshall Street, North Adams, Massachusetts.

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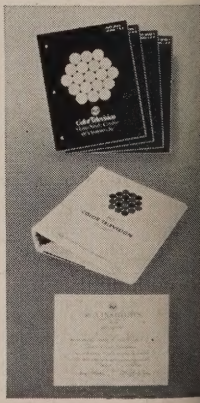
Handsome, durable 3-ring binder to keep all lessons and examinations in a permanent reference file.

RCA Institutes Color TV Graduation Certificate on completion of course—plus all regular RCA Institutes educational services to students. Graded examinations on every lesson.



RCA ELECTRON TUBE DIVISION, HARRISON, N. J.